Model Engineer

THE MAGAZINE FOR THE MECHANICALLY MINDED

EXHIBITION NUMBER

CENTRAL HALL
AUGUST 16—26

Open 11—9

ONE SHILLING 17 AUGUST 1961 VOL 125 NO 3136

17 Aug. 1961 Vol. 125 No 3136

Model Engineer

Incorporating Mechanics (Home Mechanics and English Mechanics) and Ships and Ship Models

19-20 Noel Street, London W1

Contents

Published every Thursday

Subscription 65s. (USA and Canada $9.25), post free.

Cover picture

People of all ages can find something of interest at the Model Engineer Exhibition.

Next week

Interest in axial flow and crankless i.c. engines has been revived by the unusual Selwood type recently developed. Edgar T. Westbury discusses in ME for August 24 some of the designs which have been tried.

Smoke Rings A weekly commentary by VULCAN

WHEN Sir Miles Thomas, chairman of Monsanto Chemicals Ltd, declared the Model Engineer Exhibition open at 11 a.m. yesterday he renewed an association with the magazine which fired his ambition when he was a boy.

He touched upon this on an earlier occasion, in his tribute to MODEL ENGINEER on achieving its Diamond Jubilee.

"Admittedly I must have had some kind of natural bent for mechanical things," he wrote, "and maybe this fed first on some books I found in my father's library that described early mechanical inventions and devices.

"But MODEL ENGINEER fired my boyish enthusiasm to make things that worked. It also made me realise that there were high precision standards that had to be achieved in the manufacture of even quite simple working devices.

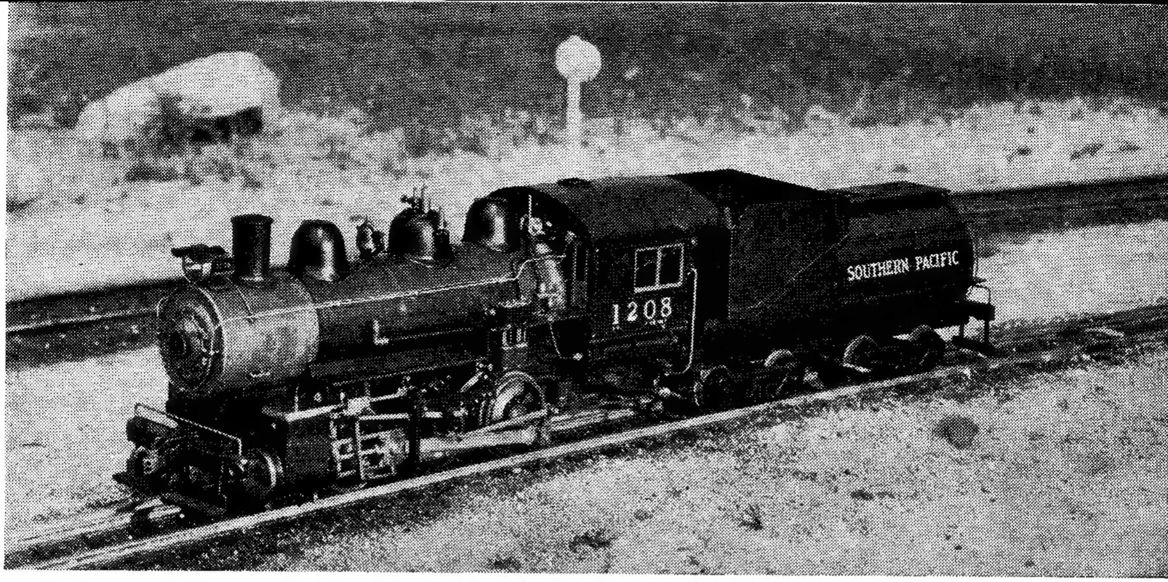
"If my experience was typical, and I would think it was so, then there must be thousands of experienced engineers today who had the first spark of ambition fired by reading this eminently practical magazine."

Sir Miles's experiences are indeed typical. They are echoed a thousand times by those of our readers. Many are the tributes which have poured into our offices from men who were led into successful careers after MODEL ENGINEER had aroused their enthusiasm for mechanical things.

Today the magazine still enjoys a strong circulation in the industrial and engineering fields and is widely read by apprentices and technicians. Perhaps, in the years to come, one of them who is now reading these words may emulate Sir Miles by performing a similar ceremony.

Meanwhile we, at Noel Street, hope those who visit the show will find it a source of enjoyment and information. There are many more models this year.

For those who cannot attend we will, during the next few weeks, bring stories about the exhibits and results of the competitions. And, for the first time, if space permits, we shall be printing pictures of all the exhibits.



Southern Pacific No 1208, *faithful to the full size, was built by Francis L. Moseley, president of the Los Angeles Live Steamers*

Visiting Europe

RUSHING in to London after a trip to the Continent, Francis L. Moseley, president of the Los Angeles Live Steamers, found time to stop off in Noel Street with his charming wife before he went out on the track of several ME advertisers.

The Los Angeles Live Steamers are flourishing. Gordon L. Sherwood, E. James Lesovsky, Max Convis, Weyland Warden, George Carson, A. R. Sutch, Richard R. Royal, C. Stan Chavil, Hervey Angier, Murvel Glass and Gene Paul—these are some of the prominent names in a society where everyone is immensely keen.

Members' engines

Every year the live steamers publish a pocket-size membership book which lists the locomotives they own, or are in process of building. You can see at a glance, for instance, that Richard B. Bagley of 1101 Ferndale, Fullerton, has a $1\frac{1}{2}$ in. 4-6-2, and that Eugene E. Bankus of 6714 Ensign Avenue, North Hollywood, is (or has been) working on a 1 in. Pacific.

I had a pleasant surprise—though it should not have been a surprise at all—to find, between Jacob Devries of 1937 Harbor Boulevard, Costa Mesa ($1\frac{1}{2}$ in. 4-4-0) and Clarence J. Downing Sr. of 1857 Los Encinas Avenue, Glendale (1 in. 4-4-2) the magic name of Walt Disney, whose 101 *Dalmatians* and *Absent-Minded Professor* are showing hardly more than a coupling wheel turn from the MODEL ENGINEER offices.

The magician runs a $1\frac{1}{2}$ in. 4-4-0. Now that Flubber has been successfully launched to a grateful world, he may be glad to relax on the track at Pasadena.

Track details

At the end of the membership book the Live Steamers give their track details.

"The Los Angeles Live Steamers' operating track," we read, "will accommodate locomotives whose wheels conform to the following specifications. These are not club standards."

For $1\frac{1}{2}$ in. scale the maximum back-to-back of flanges measurement is given as 7.125 in., the minimum tyre width as 0.750 in., the maximum flange thickness as 0.156 in., the maximum flange depth as 0.187 in. and the maximum tread width as 0.594 in.

In 1 in. scale (check gauge distance 4.531 in.) the corresponding measurements are b.b. 4.437 in., m.t.w. 0.531 in., m.f.t. 0.125 in., m.f.d. 0.156 in. (engines only; 0.188 in. for tender and car wheels) and m.t.w. 0.406 in. And in $\frac{3}{4}$ in. scale (check gauge distance 3.375 in.) they are : b.b. 31281 in., m.t.w. 0.438 in., m.f.t. 0.094 in., m.f.d. 0.094 in. and m.t.w. 0.344 in. (maximum 0.375 in.).

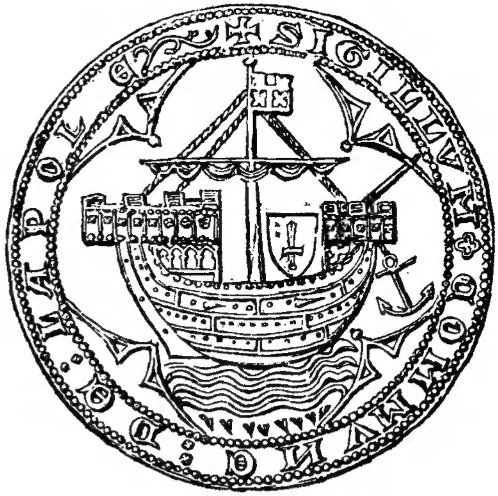
Mr Moseley lives at 700 Flintridge Avenue, Pasadena 3. The picture of his Southern Pacific 1208 is faithful to the full-size locomotive and tender.

CHUCK . . . . . . THE MUDDLE ENGINEER

Model Engineer

Exhibition preview—3

SAILS WELL SET



The Seal of Poole (1325).

The seal from which Miss Jennifer Barton obtained details for her model of an English ship of the 14th century

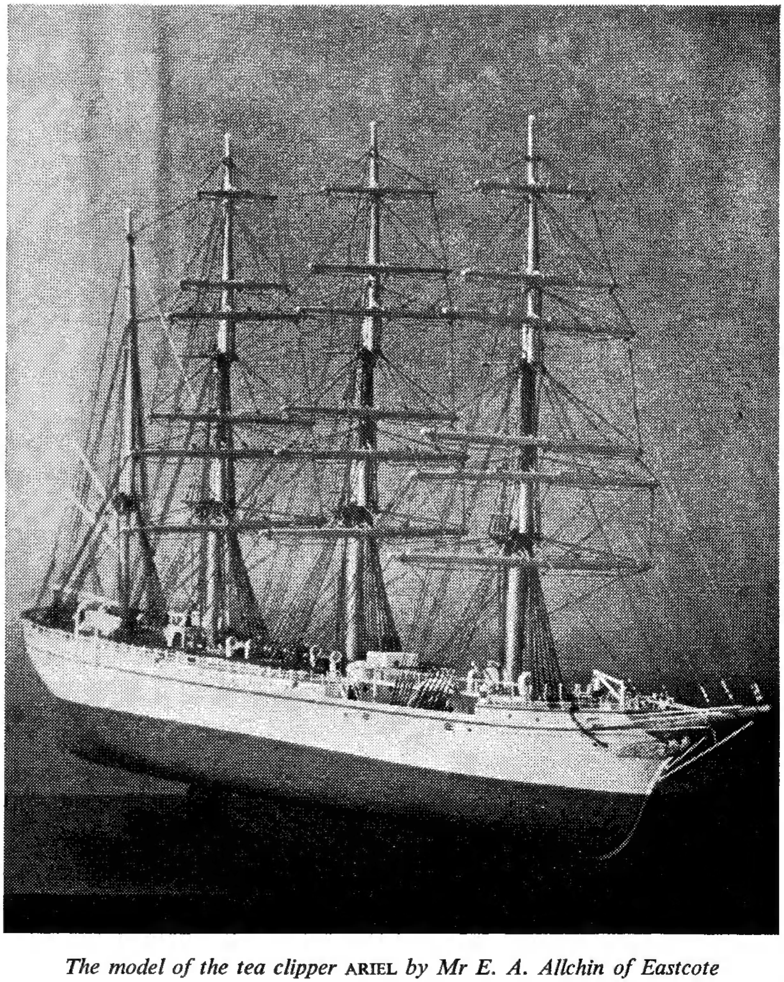
MODELS were being made centuries before Percival Marshall launched MODEL ENGINEER 63 years ago. Many of them were excellent, but they were nearly all built by lone wolves making their own painstaking research and using whatever materials and tools could be readily adapted.

But with the expert instruction which began to flow monthly, fortnightly and eventually weekly through the pages of ME the widely diffused interest of model making was integrated into a virile organised movement.

Any careful enthusiast with reasonable equipment could, with the help of MODEL ENGINEER, build a faithful miniature replica of his favourite locomotive or ship. And the more people turned to the delights of model making as a hobby, the more were manufacturers encouraged to market equipment to suit the individual needs of the home workshop.

The quality of models reached such perfection that it was felt the public ought to see some of the excellent work, which, until the first Model Engineer Exhibition of 1907, seldom graduated to a more lofty place than the parlour chiffonier or the mahogany chest of drawers in the bedroom.

The ME Exhibition brought a new conception to model engineering; here was a group of people, the public discovered, who could build models to equal any seen in the best museums. In fact, more than a few first-class exhibits in the nation's galleries have been quietly fabricated in the garden or attic workshop of some obscure model engineer.



The model of the tea clipper ARIEL *by Mr E. A. Allchin of Eastcote*

Perhaps the biggest contribution to museums has come from the ship modeller, and the reason for this is not difficult to see.

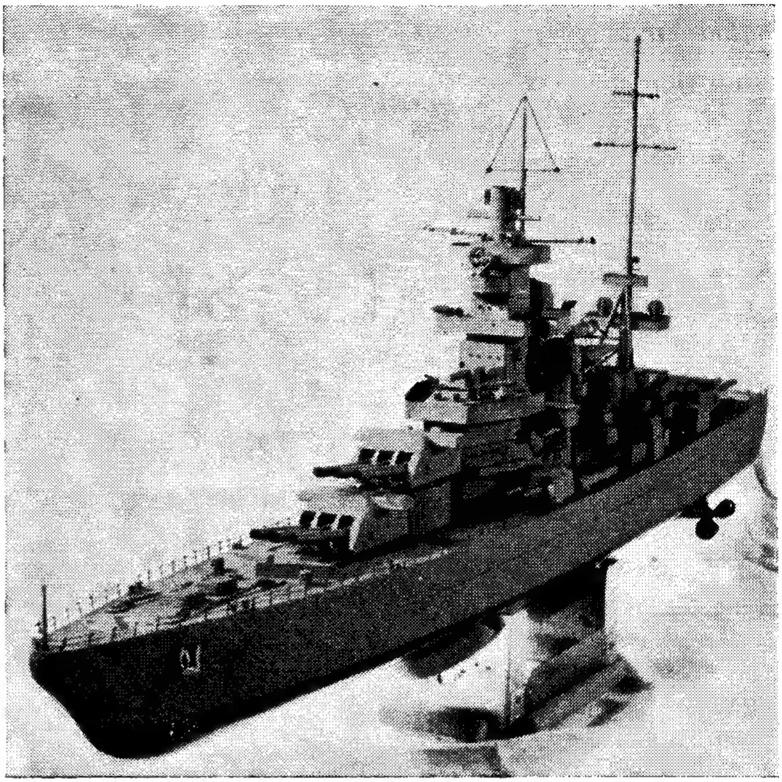
We are a maritime nation; our coasts are dotted with ports and harbours. Almost every seaside hamlet has its retired captain with either a masthead or ship's lantern symbolising his association with the sea. Our history is rich with the names of intrepid adventurers who braved unchartered oceans; of sailors who defended its shores; and of ship builders who designed the world's finest vessels.

There is another reason, too, why the biggest proportion has perhaps come from the ship modellers; they had a good start on the engineers.

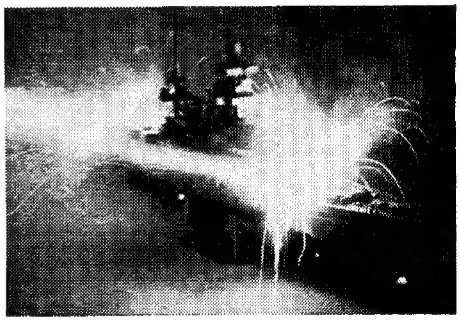
Ship modellers have been busy whittling clippers, men o' war and Chinese junks from odd pieces of wood since men first put to sea. Much of this was done by the sailor between watches, for it is the desire of almost every seaman to take into retirement a representation of the ship he loved.

Photography has now come to his aid, but before the historic work of Fox Talbot and Friese Green made this possible a sailor could make a copy only by drawing or fashioning a model.

The introduction of machine tools small enough to use in the home workshop gave the model engineer, as distinct from the ship modeller, an impetus to progress. But the ship modeller, whose work is still mostly a combination of manual skills, had the greater historical experience on which to draw.



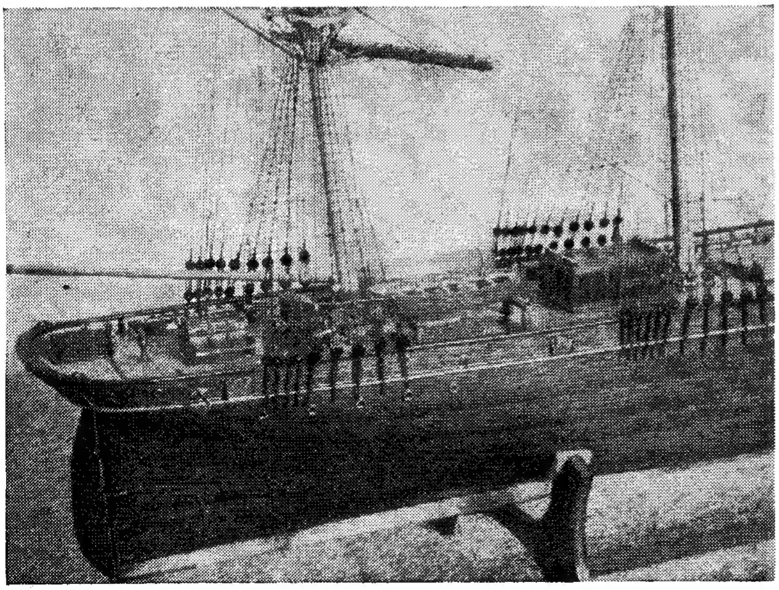
The gun-firing SCHARNHORST *by Mr R. P. Nolan of Luton. Below, right: Firing at night*



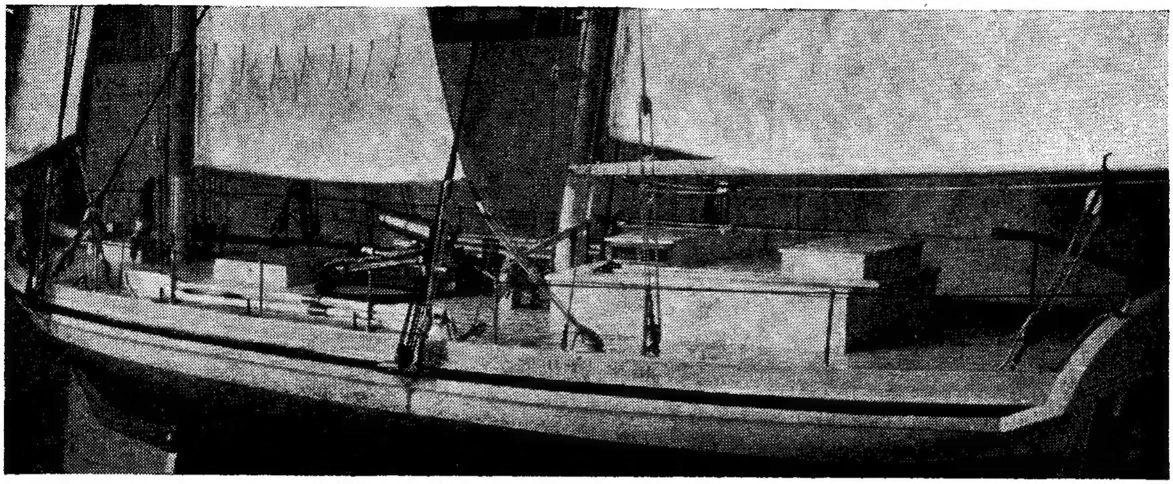
This knowledge, time spent on research, a kitchen table, a few simple tools—and the world's ships were his to copy.

The relative ease of construction, the undying interest in ships and the wealth of available data means that ship modelling is enjoyed by a substantial number of enthusiasts—a fact which is reflected every year at the Exhibition. The 1961 show again emphasises this point, for a high proportion of the entries are maritime.

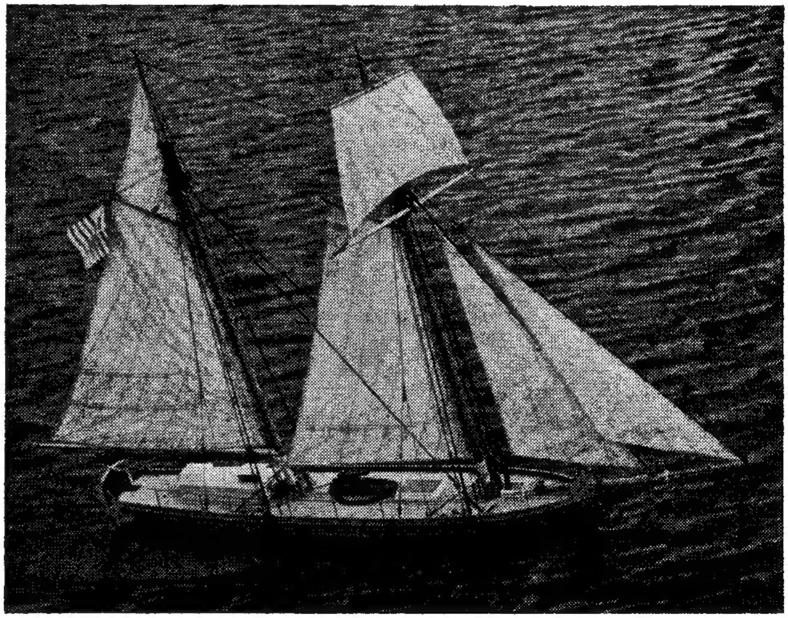
In the power boat section Mr Don S. Paterson, an architect's assistant, of Maidstone, Kent, has submitted an interesting example of a wooden



The HERZOGIN CECILIE *by Mr W. Lane of Margate*



Above: Deck view of a United States revenue cutter (circa 1815) by Mr. J. A. Thompson of Leicester. Below: On a test sail



steam drifter. *Young Cliff*, as he has named his model, was designed and constructed from personal observation of the full-size craft at Yarmouth.

The interior of the wheelhouse is fully fitted, with such tiny details as leather straps to the windows. The capstan is steam driven, the running rigging is spliced, there is a working molgogga fairlead and the skylights are made to open. It had preliminary trials at Lowestoft this summer.

Another model which has sailed on several occasions is *St Ninian*, scale 1/5 in. to 1 ft, built by Mr D. R. Davidson, an engineering inspector of Brentwood, Essex.

As one would expect, it has been constructed from the plans and description which appeared in MODEL ENGINEER, though the modeller has made one or two departures in technique. It is electrically driven and can be controlled by radio.

Two fine warships

A ship which will delight the many youngsters who flock to the show is that entered by Mr Roger Nolan, a fitter working with English Electric. This is a 3 ft 2 in. model of the German battle cruiser *Scharnhorst*.

The constructor, with immense ingenuity, has made the main guns so that they can rotate, elevate, depress and fire shells.

Anchors can be raised and lowered by motor and it is electrically powered, the single motor driving twin screws. Details for its construction were secured from photographs obtained from the Imperial War Museum.

Also in the warship category is Mr J. Brown's HMS *Illustrious*, complete with model aircraft.

Mr Arthur Sallis of Brighton is well known to south coast modellers for his shop in North Street, and his interest in radio control. It is not surprising that his entry should be a radio controller's dream; his 1 in. scale version of a 52 ft Barnet class lifeboat has 24-channel equipment.

A turbocraft

An unusual little craft in the power boat section is a model of a Dowty turbocraft shown by Mr J. F. Coppin. of Chiswick. The hull is made of fibre glass and the power unit, according to the builder, " is a simple jet."

Modellers are often inspired to build a ship model, particularly a sailing ship, after having read a book giving intimate details of the craft. Mr Turner's *Wanderer*, which was built after the modeller read John Masefield's book of the same name, was an example from the 1959-1960 Exhibition. This year's illustration is supplied by Mr A. K. Williams, a chartered accountant of Burgess Hill, Sussex, who modelled a double canoe, of the kind in which the Polynesians made their historic ocean voyages, after he read *The Cruise of the Amaryllis* by J. H. B. Muhlhauser. The model is 17 in. long, by 14 in. wide and 17 in. high.

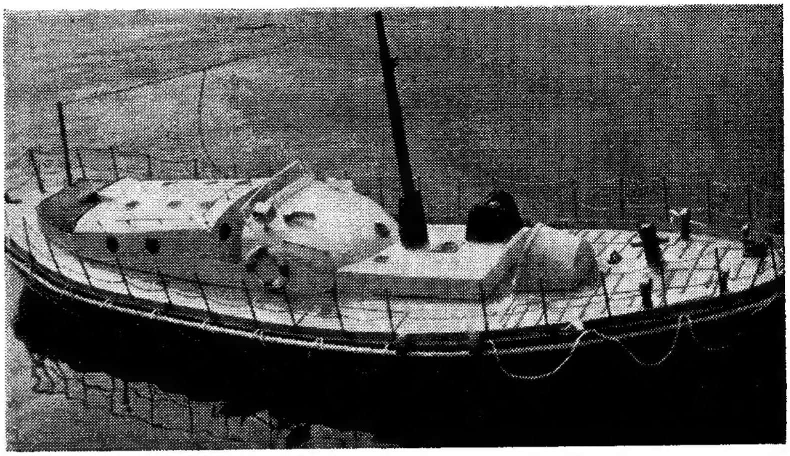
Sailing ships form a substantial collection of the marine section and are representative of widely different types of craft.

Mr Frank Hinchcliffe's model of HM Brig *Martin* of 1836, built to ¼ in. scale, was made "to fulfil the desire to own a fully detailed but working model at the first attempt."

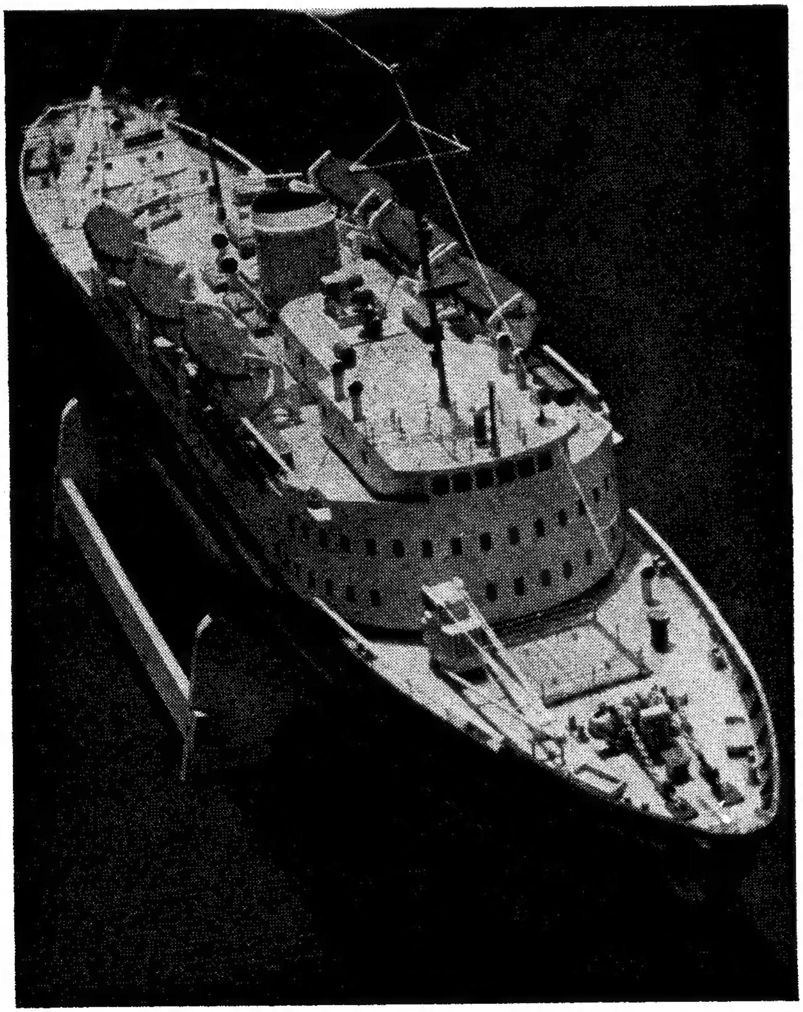
From Potters Bar comes a 1/36 in. scale model of a Roman merchant ship of the second century. Constructor is Mr J. M. Russell, a student teacher.

Different again is the ⅜ in. to 1 ft model of a US Revenue cutter of the type designed by William Doughty between the years 1813-1837.

In the non-working sailing ships Mr R. G. Hutson, a coach body-maker of Watford, has entered a 1/200 in. scale version of the sailing warship *Adler von Lubeck*.



A cabin lifeboat by D. J. Turner of Rochester



ST NINIAN, *after two years' work, by Mr D. R. Davidson of Brentwood*

Mr L. C. Gough's gun brig, *circa* 1800, made to 1/5 in. to 1 ft scale, has planked boxwood decks and is copper plated below the low waterline. It sits in a sea of glass.

The great sailing ships of the last century are firm favourites with many modellers. One which has attracted many enthusiasts in the past—and will doubtless inspire them in the future—is the four-masted barque *Herzogin Cecilie*, so tragically wrecked on the Devon coast.

It is represented this year by Mr E. V. Lane's model to the rather odd scale of 1 in. to 9½ ft, and made from plans obtained from *The Tall Ships Pass*, by W. L. A. Derby.

In the working sailing models Mr W. Brewer, a London taxi driver whose interest chiefly lies with tugs and trawlers, has entered a ⅜ in. to 1 ft model of a Lowestoft sailing trawler. The rigging has been modified from the plans designed by Edgar J. March to allow for the model to be dismantled. The stand on which it is mounted bears the arms of the town of Lowestoft.

The great ships are represented again by *Ariel* shown by Mr E. A. Allchin, a coach builder of Ruislip. The model is built with 24 sets of laminated ribs, diagonally planked and longitudinally planked. There are 11 watertight bulkheads.

Mr Allchin has avoided increased depth and width, there is no false keel or false rudder, yet the model, he claims, sails well and is surprisingly stable.

Taken in all, this year's maritime section has a good trim set to its sail. ■

Behind the model lies a story

From St Dunstan's comes an engine by a man who is completely blind, and from America one by a man who is paralysed

OFTEN the visitor to the Model Engineer Exhibition does not know the story behind some of the models. Two of this year's stationary engines, for instance, are of special interest, because one of them was built by C. Wills, a totally blind patient at St Dunstan's, and the other by an American who is paralysed and has the use of only three fingers.

The large "O" class submarine in fibreglass by David Ashton is still unfinished. When it is completed, it will be able to fire guns, rockets, torpedoes and underwater Polaris missiles, to travel underwater, and to do all that a normal submarine can do as well as some things of which a naval submarine is incapable.

From across the Atlantic comes a second unusual submarine, an unfinished model of the skeleton structure of USN S.51. Another unfinished entry is Leslie Tether's thirteenth century English ship and boat, as Mr Tether describes it.

Apprentices can usually be expected to show some very fine work. Among the entries are two by the marine engineering apprentices of Green and Silley, Weirs Ltd. Besides a 3½ in. gauge live-steam Pacific which has been constructed entirely without the use of castings and is provided with steam brakes, they show a taper gauge designed by themselves. Its task is to measure the internal taper of the shaft bore on ships' propellers.

The BR Apprentices' School at Crewe was represented last year by a 3½ in. gauge model of Churchward's *Great Bear*. This year it has two entries. One is a 3½ in. gauge model of an Aspinall Lancashire and Yorkshire Railway Atlantic, and the other a modern BR diesel electric locomotive.

Most people throw matchsticks away when they have used them—but not Harold Hughes. He collects them and makes them into models. His latest creation is a model of the liner *La Orilla* which contains 13,700 matchsticks. The vessel measures 6 ft.

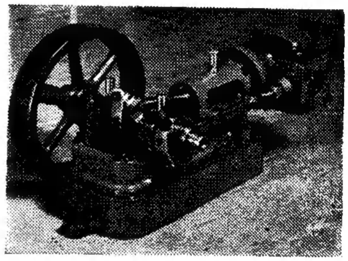
While Mr Hughes uses matches, Mr D. Haws prefers paper, cardboard, needles, pins and cotton. He specialises in small waterline ship models, and so far he has constructed 861, of which 506 will be on show. The collection is believed to be the largest built by any one man.

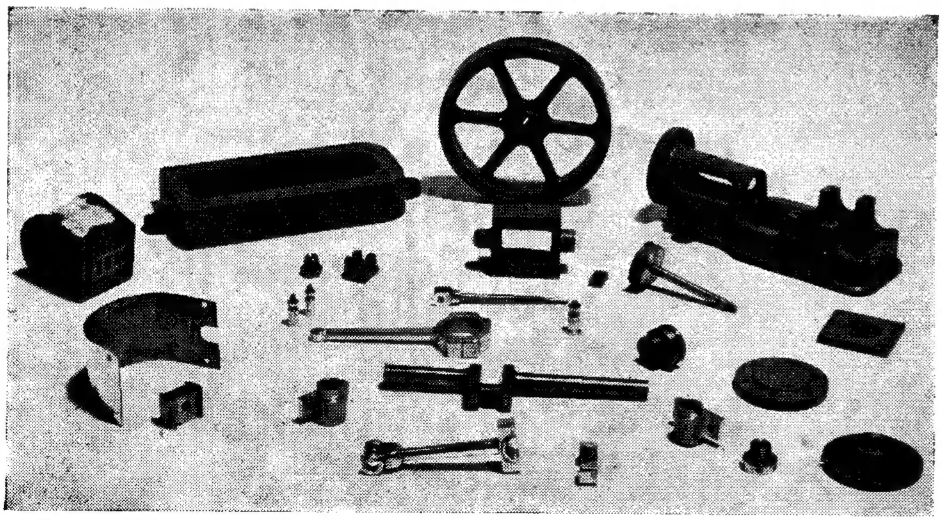
Older modellers will have to look to their laurels, judging by the standard of the work sent in by the juniors. Take the stationary engine from L. Gray of Strood. After a year's practical metalwork, this boy of fifteen has built the Stuart Turner No 10H stationary engine.

One of the most interesting exhibits for the Duke of Edinburgh Trophy has suffered damage by vandalism. It is a three-dimensional model depicting the death of Nelson and has been entered by the Curator of the HMS *Victory* Museum at Portsmouth. Recently the model was broken open in the museum and some of the figures were stolen. It is unlikely that new figures can be made before the exhibition.

As usual, the Loan Section of the exhibition produces some very interesting models. Among the locomotives, an outstanding model is the magnificent 5 in. gauge LNWR *George the Fifth* 4-4-0 by Mr George Cashmore, the chairman of North London SMEE. K. E. Wilson has entered a pair of 3½ in. GWR City class 4-4-0s.

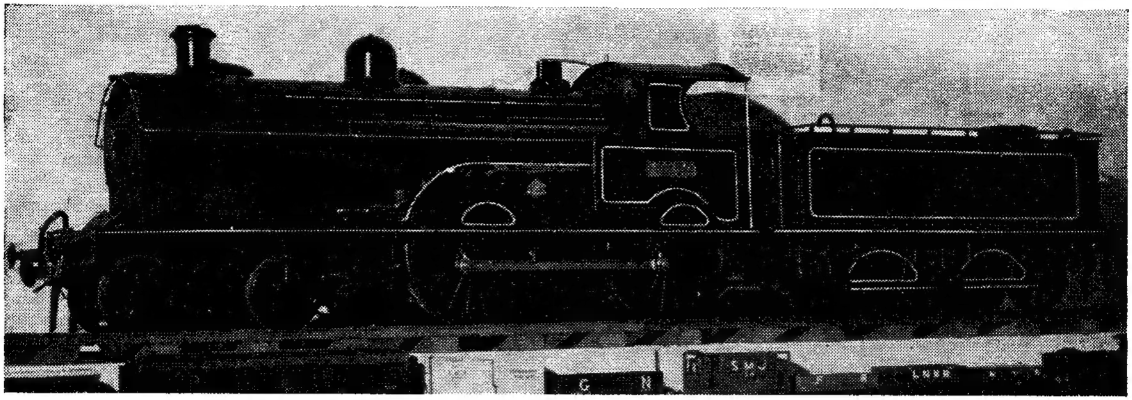
Claude Reeve, the quiet amateur horologist, exhibits another clock,





Above: It was a boy of 15 who made this Stuart Turner engine

Left: Parts of the engine unassembled



George Cashmore's George V class engine in 5 in. gauge

and Donald McNarry, the wizard of miniature shipmodelling, shows his 32 ft to 1 in. model of the brig *Herzogin Cecilie*. From B. A. Knight comes a hot air engine.

In the centre of the exhibition will stand an old favourite—Mr Herbert Slack's organ and roundabout. This wonderful model won the Duke of Edinburgh Trophy a few years ago. The detail and finish are amazing.

At various times during the ten days, several companies are giving demonstrations. Kennion's of Hertford, the well-known suppliers of model engineering goods, are giving demonstrations of brazing and silver soldering boilers. There, too, are Myers Ltd, manufacturers of low pressure gas equipment. Radio-control equipment is demonstrated by Reading Model Supplies, and aircraft engines are set to work by Performance Kits. Valtock, the wrench and blowlamp manufacturers, and the Eutectic welding team, show how welding should be done.

Besides the demonstrations by the trade, there will be continuous demonstrations by amateurs. E. C. Freeston, George Draper and R. J. Collins will be explaining ship modelling techniques, and Claude Reeve will reveal how his beautiful clocks are made. The Enfield Technical School will be demonstrating modern workshop practice, and the Sparbrook MAC team—C. J. Percival, H. C. Heywood and N. Wallis—the building of model aircraft.

The small size of Central Hall rules out the live steam track, boating pool and flying cage, but the clubs who usually man these exhibits will be in attendance: the Society of Model and Experimental Engineers, the North London SMEE, the Metropolitan Ship Model Society, and the Society of Model Aeronautical Engineers.

Trade standards are occupied by Hobbies, Myford, Stuart Turner, T. W. Seniers, G. H. Albon and MODEL ENGINEER.

It all adds up to an attractive show. Next year we may have more space at our disposal. Meanwhile you can enjoy the exhibition as much as you have enjoyed it in the past. ▣

FOR YOUR BOOKSHELF

The Arbroath Affair, *by Ian N. Fraser (Fraser)* 7s.

IAN N. FRASER, of Arbroath, will long be remembered among traction engine enthusiasts as the man who made history.

When he was refused planning permission to erect a traction engine house adjacent to his new home in a residential district of the town he, like many a Scot before him, decided to challenge his oppressor.

The outcome was a protracted exchange with bureaucracy that finally went to the Secretary of State for Scotland where Mr Fraser finally won the day.

Readers were kept abreast with current reports of events and Kenneth Barrett summarised the entire story, on the successful conclusion of the case, in MODEL ENGINEER for 26 November 1959.

Now Mr Fraser has compiled a small book which gives the complete history and is well illustrated with photographs taken at the time.

For those who would like to delve deeper into the issues involved it provides all the answers. Copies may be had from Percival Marshall Ltd, 19-20 Noel Street, London W1. Price 7s., or 7s. 6d. by post.

The History of the Dorking Greystone Lime Co. Ltd., and the Locomotive Townsend Hook. *By J. L. Townsend. (Narrow Gauge Railway Society). Price 3s. 6d.*

THE preservation of this 3 ft $2\frac{1}{4}$ in. gauge Fletcher Jennings locomotive is by now common knowledge. But the history of the locomotive is unique and it makes fascinating reading.

The quarry in Surrey where it worked is full of interest for the mechanically-minded. The author, John Townsend who was responsible for the preservation scheme which saved *Townsend Hook* from scrap has an intimate knowledge of the site and the locomotive and has spared no pains to make the booklet as interesting and concise as possible.

One chapter deals with work of that great firm of locomotive builders, Fletcher Jennings. Had it not been for the disastrous fire in the early part of the century they may have become one of the greatest locomotive builders in the country.

For the narrow gauge railway enthusiast this booklet is a must. There are plenty of facts and figures, and illustrations depicting the locomotive throughout its life.

Mr Townsend tells the stories of the development of the quarry, of the life of the locomotive and the history of Fletcher Jennings in a friendly style which is a pleasant variation from the monotonous drone often produced by those who are devoted to the preservation of locomotives.

This is the best booklet yet published by the society, and excellent value for the money.—R.O.

SIMPLE JIGS and TEMPLATES

WORKSHOP HINTS and TIPS

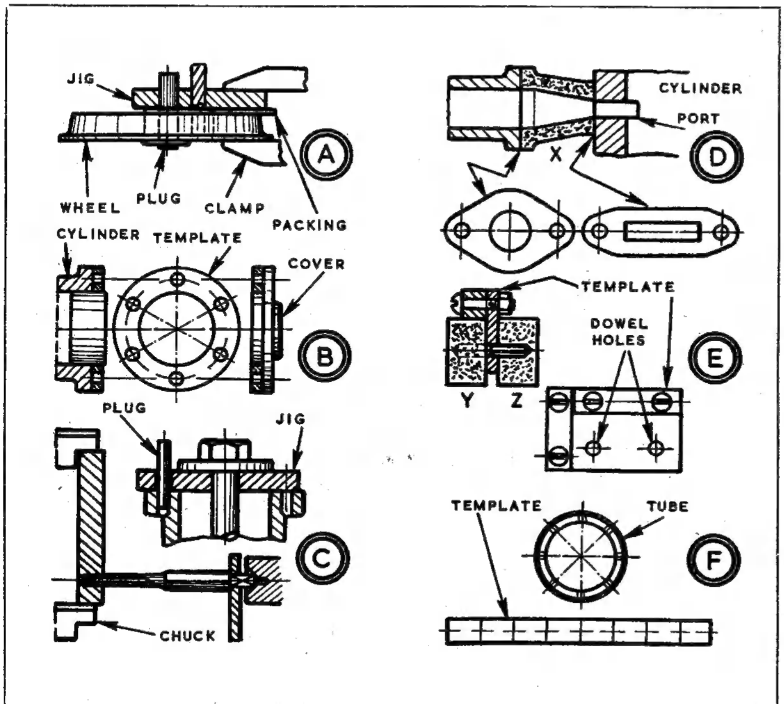
By GEOMETER

Even on the one-off jobs with which model engineers are chiefly concerned, simple jigs and templates can be a very helpful means to accuracy in a variety of operations, such as drilling, tapping, filing, marking-off and dividing. Often, too, they save considerable time, as well as eliminating the hazards that beset many operations.

For instance, if a mistake occurs in making a template, no harm is done. There may have been an error in marking off, or the drill may have run from position. In either instance, a second template can always be made—but it is another thing if the mistake is on a component, such as a casting.

Again, a jig or template can be essential if there is a slight flaw, such as a tiny blow-hole, in a surface where a hole is to be drilled. Possibly the flaw would be taken out in the drilling—but not before it had drawn the drill off course; whereas, with a jig, and with care, the drill will penetrate truly, uninfluenced by the flaw.

By using a jig, the crankpin hole in a locomotive wheel can be drilled accurately in position, as at *A*. The coupled wheels are drilled the same; and with the pins in all wheels having a like throw, the coupling rods run freely without excessive clearance in the bores. Sometimes, of course, one wheel can be drilled first and used as a jig for the others, mounting it to each by a plug in the bore. With two wheels clamped face to face, the drill is run from the back of the drilled one.



A large steel washer will serve as the drilling template for a steam cylinder and its covers, as at *B*. Alternatively, a piece of thick sheet metal or thin plate can be marked off, bored, and drilled for the same purpose. This avoids scribing lines on the cover, which would otherwise have to be done for it to be used as a template for the cylinder. A template of this type should be used with its respective faces to pairs of parts—one face to the cylinder (with a locating plug in the bore), the other face to the cover (where the spigot provides location). Finally, a tiny centre punch dot near a corresponding hole in the cylinder and cover indicates the rotational setting.

The tapping of holes is sometimes accompanied by difficulties which can be avoided by using a jig. There is the ever-present problem of keeping the tap square, to which can be added others when holes are relatively shallow. The tap may not bite at first, and a few poor attempts may ruin the hole. Hence, when difficulties are foreseen, a tapping jig, as at *C*, is advisable. It can be from flat bar, drilled, tapped and faced in the independent chuck for accuracy. With a tapping size plug in the hole to be tapped, the jig can be located and clamped—or held by a through-bolt to a cylinder. With the plug removed, a second tap can be run in carefully, followed by a plug tap.

Holes tapped by this method are square with the face of the work, and the threads are full depth all the way. A slight chamfer can be given to the tops of holes by a sharp drill, twisted in fingers.

When parts must be filed to match one another—it cannot be done with them clamped together—a template gives accuracy, used on one and then the other. An example is the fitting of a carburettor to the cylinder of a two-stroke engine. The bore of the carburettor is round, the port in the cylinder a slot. As at *D*, a special distance piece *X* can be used between them, drilled, milled, and finally filed to template to match the port in the cylinder.

By using a template, dowel holes can be drilled in the abutting faces of two parts to be invisible. In the example at *E*, the template is located on short dowels; and with parts *Y-Z* on a flat surface, strips are screwed to the template to locate it for drilling holes in *Y*.

For semi-precise locations, like centres of rivet holes, templates of paper aid in marking off at times—as at *F*, where holes are spaced round a tube, using a divided strip. ■

Glass breakage inspired CHARLES KALISH of New York to make his own coverings and bases for his collection of little clocks

DISPLAY CASE IN PLASTIC

QUITE a long time ago, I bought a small Japanese striking bracket clock on its original Shitan wood base, with the original glass case. After having been shipped from Europe, the case arrived in such a damaged state that I was disappointed and made no further purchases from the Continental dealer who had sold it to me. The damage had been caused by faulty packing.

One of my collector friends to whom I proudly showed the clock told me it would be quite simple to make a plastic replacement case instead of a fragile glass one. He volunteered to help me make it if I would obtain the material. This seemed like an excellent idea. We promptly took the necessary measurements and arranged to work at his home.

Playing hookey from the office that day, I took the clock and base with me, and on the way to his home I stopped and bought the material. We did the work in what seemed to be no time at all.

Thus encouraged, I ventured on my own and made a few cases to house some of my very delicate miniature clocks. When my friend Charles Terwilliger came along with his fascinating reproduction of the Ignatz clock I had to make another, this time with a base. As my collecting friends admire these plastic cases, I think the procedure for making them may help others.

A rather simple jig is needed to help hold the pieces in position while they are cemented. I made mine out of two pieces of aluminium, but heavy plywood serves equally well. Be sure you have a perfect right angle. The size of the jig parts is not important. Mine is 12 in. long × 10 in. wide and 4 in. high for the angle.

Calculating the pieces for the case is easy. Determine with a ruler what you require. Let's say that you need a case whose inside dimensions are 6 in. long, 4 in. wide and 3 in. high. A small amount of oversizing is desirable. I generally allow myself ⅛ in. for each inside dimension for small cases, and ¼ in. for larger ones. Assuming the material to be ⅛ in. thick, you would require:

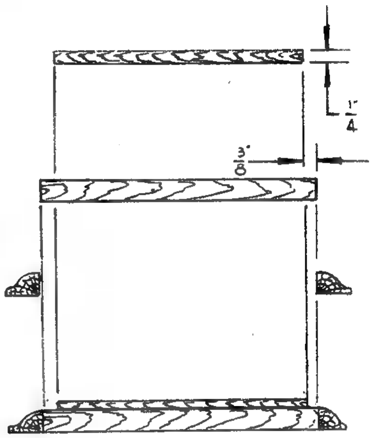
Two pieces (sides) 6⅜ in. × 3⅛ in.
Two pieces (ends) 4⅛ in. × 3⅛ in.
One piece (top) 6⅜ in. × 4⅜ in.

They can be bought cut to size, or they can be cut from large sheets on a table saw or with a portable jigsaw. Plexiglas or Lucite is sold at surplus stores and by plastic distributors.

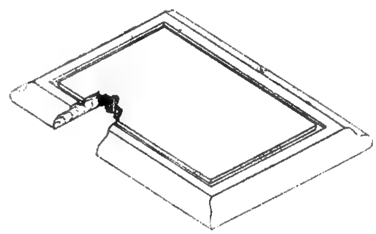
After cutting, take one of the sides (6⅜ in. × 3⅛ in.) and lay it down on the jig so that the 3⅛ in. dimension is flush against the right angle of the jig. Then take one of the end pieces (4⅛ in. × 3⅛ in.) and put it in the vertical position flush against the vertical side of the jig so that the 3⅛ in. dimensions match perfectly. Put a small but heavy weight on top of the side and push it against the end piece to hold this firmly in place while you are cementing. Take a small artist's paint brush, and after dipping it in the cement run it along the joint. You can see the capillary action pull the cement in to make the bond. Wait five minutes for the cement to set, take the weight away, and cement the part which you were unable to reach because the weight prevented it. Again wait a few minutes.

Next, turn the side around and put the other end in place. Using the weight again, cement the joint. Wait till it sets, remove the weight, and cement the part which you missed. Wait again. Take the remaining side, put it down flat, place the three-sided frame on top in the correct position, and cement the two inside joints. You can put a weight on top to prevent shifting during the cementing. After the cement has set, remove the frame and complete the case by putting the top flat on the jig. Place the frame correctly in position on top of it. Cement the inside joints.

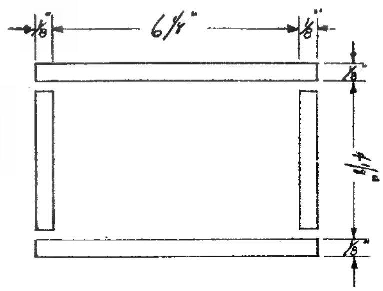
You should make sure that the pieces line up properly when you are putting them together, or the case will not stand level. Notice that the cemented joints appear to have acquired a polish and that they have



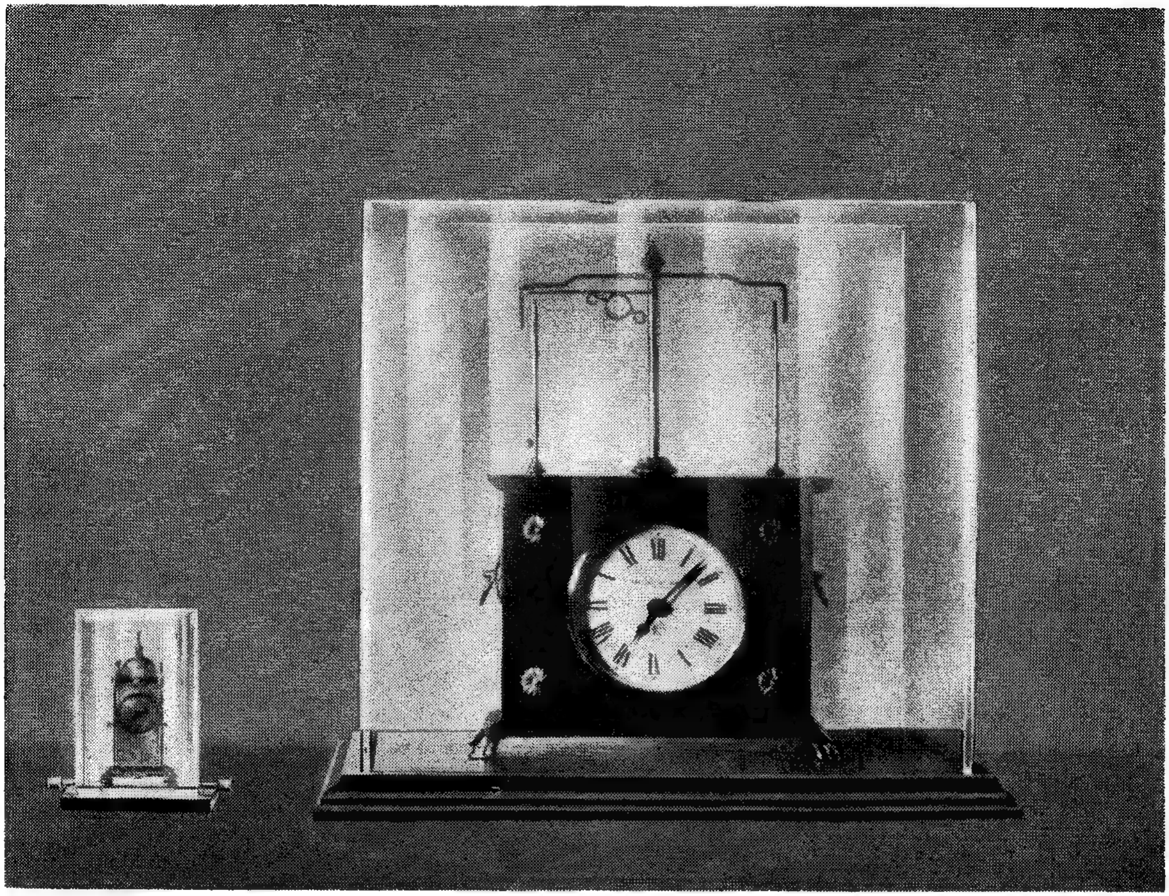
Constructing the base without a router



Constructing it with a router



How to compute the size of the frame



Ignatz clock in plastic case. The diminutive case beside it has [redacted] base of plastic-on-plastic. Screws in the side permit the clock to be removed easily

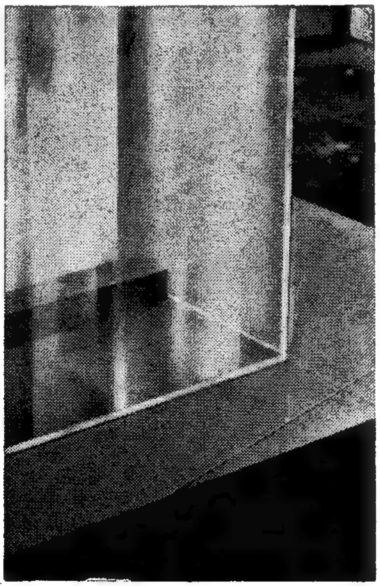
a satisfactory clear look. You can polish the outside edges which were saw-cut on [redacted] buffing wheel, and they too will become clear and lustrous.

Sometimes it becomes important to have a base. For example, the Ignatz clock needed [redacted] rather large case, to be held at certain distances from the clock, as the ball had to have freedom in all directions. I therefore made [redacted] base, using my router to decorate the outside edges with [redacted] moulding trim; I cut [redacted] groove in the base to establish [redacted] fixed position for the plastic [redacted] to sit in, and marked the base for the clock feet.

You may not have [redacted] router, or the object to be mounted may deserve [redacted] higher pedestal, so to speak. If the clock can be firmly screwed to the base and should have [redacted] little more height, I take [redacted] second piece of wood, somewhat thinner and smaller than the outside base put plush around it, and fasten it centrally to the base proper. I arrange my [redacted] to fit around this raised upper section. If you have no router, you can tack on moulding around the outer edges. If the router is handy, you [redacted] also bevel the outer plastic case edges before cementing and polishing. The rounded corners look well.

The distributors of this transparent plastic material have dyes for it. I have, on [redacted] of the very diminutive cases, made the bases of plastic [redacted] plastic, dyeing the bottom piece. The longer you leave the plastic in the dye, the deeper the colour and the less transparent it becomes. Finishes for wood are no problem; paint or stain does equally well.

I have been buying my plastic supplies from Commercial Plastics, 630 Broadway, New York 12, New York. They have their own brand of cement which they call Plexite Cement; the chemical [redacted] for it is methylene chloride. ▣



Left: Jig with pieces held in position for cementing with the help of [redacted] weight

ROBIN ORCHARD concludes his series on the last BR engines to be built for steam

EVENING STAR WILL ALWAYS SHINE

THE BR 1C tender has the same water capacity as the B but its coal capacity is nine tons. When it is fitted to the normal 2-10-0s the weight totals 139 tons 19 cwt.

By far the heaviest of all the BR tenders is the BR 1F which carries 5,625 gallons of water and seven tons of coal. When it is attached to a 9F, the scales swing round to 141 tons 19 cwt.

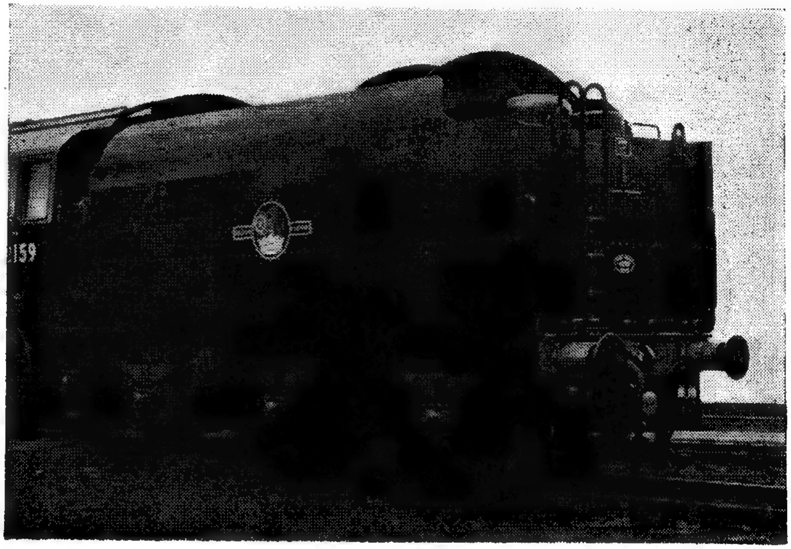
The BR 1G tender has a smaller water capacity than the F but is higher than the others to avoid the risk of running dry on lines where watering points are sparse. It carries 5,000 gallons of water and seven tons of coal. A 9F with this tender behind it weighs 139 tons 4 cwt.

Fitted to the three mechanical stokered locomotives is the special BR 1K tender which carries 4,325 gallons of water and nine tons of coal. It makes the total weight of locomotive and tender 139 tons 1 cwt.

All the 9F class locomotives are painted in unlined black, with the number on the cab side and the usual cast number plate on the smokebox door. The earlier ones were originally adorned with the old crest.

No 92220 is painted specially in passenger green, is fully lined and carries a copper cap to its double chimney. This Western Region engine based at Cardiff Canton is classified for route availability by the colour blue—a light blue circle below the number, which is in cream, with a black edge. Blue route availability puts it at a much higher advantage than other Western Region engines, for even classes like the Counties, Halls and Granges are given a red. The only GWR tender locomotives with equal availability are the 2800, 4300 Manors and 2251 classes. This explains why they are so popular with the operating staff.

The plate on the smoke deflectors of *Evening Star* is in cast steel, with raised characters and black background. Below it is a smaller plate, the commemoration plaque inscribed: *No* 92220 *built at Swindon, March* 1960. *The last steam locomotive for British Railways. Named at Swindon on March* 18*th* 1960 *by K. W. C. Grand Esq. Member of the British Transport Commission.* I shall never forget how beautiful *Evening Star* looked on that day and how sad were the faces of Sir William Stanier, Mr Oliver Vaughan Bulleid, Mr H. G. Ivatt, Mr F. W. Hawksworth and



BR 1C tender on No 92159

AN ME STAFF FEATURE

Continued from August 3, pages 141 to 143

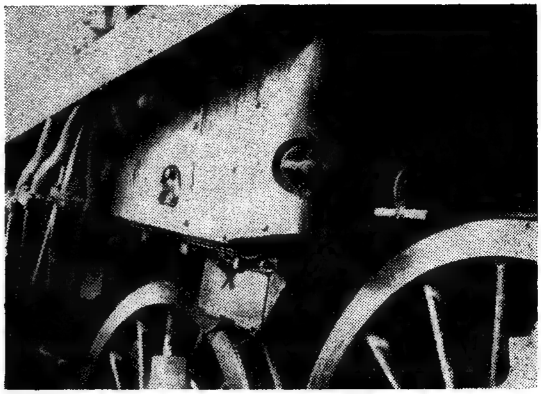
Largest standard tender, the BR 1F

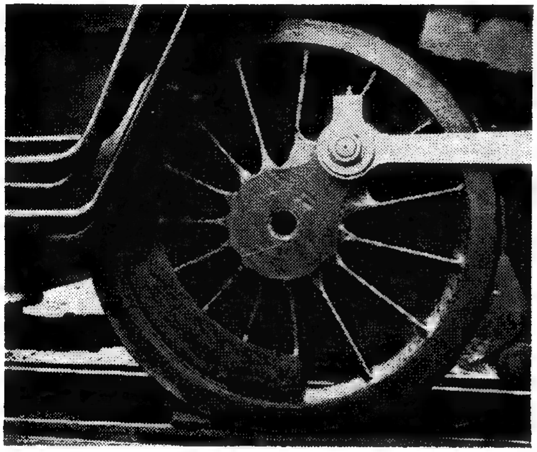
Mr R. A. Riddles, men to whom the steam locomotive has meant a lifetime of study and design.

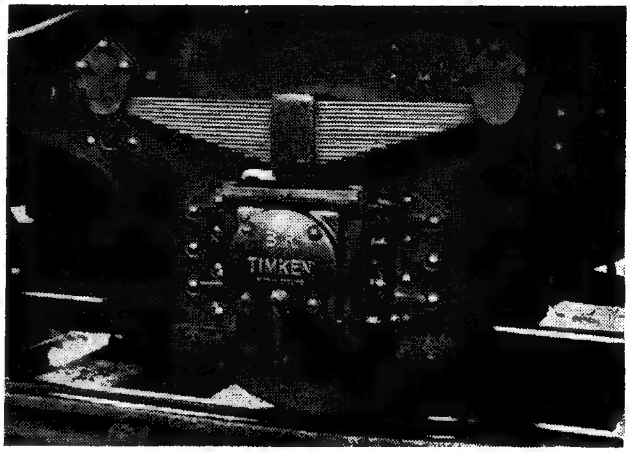
When the withdrawal of these fine engines becomes necessary, as it will in years to come, *Evening Star* will not be scrapped, for it is the intention of the British Transport Commission to preserve her.

I would like to thank the Western Region Press Officer Mr C. J. Rider and the Shed Master at Cardiff Canton for arranging for Brian Western and myself to photograph EVENING STAR, *and the LM Region Press Officer for some of the other photographs.*

Firebox is carried above rear coupled wheels of 9F engine







Below, left: Rear of a BR 1C tender. Right: A BR 1K is fitted to the three engines which have mechanical stokers
The pictures of 92159, 92037 and 92167 are by courtesy of BR; the other photographs are by Brian Western

NEWS REPORT—I

POWER ON THE POND at Sheffield

Latest fashions in headgear for model boat enthusiasts. Left to right: Mac Eason, Leslie Leach and Gordon Dwyer

By JAMES HOLT

WHEN Sheffield Ship Model Society held its first regatta of the 1961 season at Firth Park Model Boat Pond, the balloon bursting contest for radio-control boats had to be cancelled because of the large entry.

Hard chine boats were predominant. Only four boats of the round bilge prototype class were entered, and two of them were veterans: Arthur Winterbottom's tug *Thresher* and Alan Slack's Spanish fishing vessel.

This reflects the modern tendency for a quickly-built boat powered by a commercial engine or electric motor, and designed primarily for radio control. It is true that much ingenuity is used, and much time is spent in experimenting on the radio equipment—there was not a single radio failure throughout the afternoon—but we missed the fleet of trawlers, tugs and liners, which we once associated with the Sheffield Society, and which had obviously been built with a true regard for the original rather than as a means to an end.

Outstanding among the many new boats was a beautifully made ½ in. scale model of the London cement tug *Serona* by Ian Ford. It gained fourth place in the free-running steering event and was third in radio-control steering.

The other newcomer in the round-bilge class was Gordon Dwyer's gunboat, which won the radio-control steering event. This boat is as yet unfinished; it will undoubtedly be a very fine model.

Another new boat which performed well was the

Right, top: Arthur Winterbottom with his nippy ARDRECH. *Centre: An air-sea rescue launch was run by John Bonser. Opposite: Ian Ford starts his* SERONA. *The radio control servo is home-made. Left: Standing is John Beal, the club secretary. Douglas Hill, who is seated, was with him as his fellow timekeeper*

FREE-RUNNING STEERING

1. Arthur Winterbottom	*Freelance launch*	... 3 + 3 + 1 = 7	points
2. Gordon Dwyer ...	... *Gunboat* ...	... 0 + 3 + 1 = 4	,,
3. Ian Mettam ...	... *Freelance launch*	... 2 + 0 + 1 = 3	,,
4. Ian Ford ...	... *Tug Serona* ...	... 1 + 1 + 0 = 2	,,

NOMINATION

		Nominated secs.	Actual secs.	Error per cent.
1. Ian Mettam	... *Freelance launch*	40.0	40.0	—
2. Mac Eason	... *Vosper fire tender*	30.5	30.3	0.68
3. Gordon Dwyer	*Gunboat*	22.5	22.3	0.88
4. L[redacted] L[redacted]h	... *Cabin cruiser Eileen*	9.5	9.6	1.05

RADIO CONTROL STEERING

1. Gordon Dwyer	*Gunboat*	16	points
2. John Bonser	*A.S.R.L.*	14	,,
2. Dave Lee	*Cabin cruiser*	14	,,
3. Ian Ford	*Tug Serona*	13	,,
4. Harry Bonser	*A.S.R.L.*	12	,,

small freelance launch *Ardrech*, which Arthur Winterbottom had built for a young enthusiast in France. It was undergoing its trials in this regatta; and it proved itself by winning the free-running steering event. Obviously it will give many hours of pleasure to its new owner.

A fourth new boat to be successful was a hard chine freelance launch by Ian Mettam. It won the nomination race with no error. The event was closely contested, and Leslie Leach, with only one-tenth of a second error, was in fourth place.

Mac Eason, [redacted] junior member, was second in the nomination with a very attractive model of [redacted] Vosper fire tender. He is thirteen.

Mr J. Beal of 89 Norton Lane, Sheffield 8, is secretary of the society. ▣

NEWS REPORT—2

RAIN AT ROCHDALE—but nobody minded

AFTER a month of virtual drought, rain poured down at the official opening of the new track at Rochdale.

As Alderman Bossier was president of the Rochdale SMEE, and the local council had greatly encouraged the club, it was doubly appropriate that he should perform the opening. He did this by being the first passenger, with his wife, behind David Woolfenden at the controls of *Duchess of Buccleuch*, and by breaking a tape at the beginning of his first lap. The ¾ in. scale *Duchess* has four cylinders and great power. She made [redacted] bad start four years ago when her boiler ran dry and burnt out through blocked passages in the water-gauge. With her second boiler she steams like [redacted] witch; when I drove her later, I found it difficult to keep the safety valves on their seats.

The track itself is an excellent piece of engineering, with concrete arches cast on the spot. Of its 726 ft, [redacted] stretch of 216 ft is straight, with 40 ft radius curves of rather more than 180 deg. at each end, so that the track bows inwards on a sweeping reverse curve opposite to the long straight run. In one corner [redacted] locomotive transporter carries engines from the steaming bays to the track and back again. On the straight is [redacted] stout wooden overbridge for foot-passengers' safety.

Three gauges—2½ in., 3½ in. and 5 in.—are used. The rails are mild steel bar with through-bolts and spacers, further secured by being grouted to the arches with cement. One visitor thought that the grouting gave [redacted] harder ride than wooden sleepers, but this is debatable.

Part of the track runs in a cutting about 4 ft deep. The Rochdale [redacted] have worked very hard to carry out the whole of the work in well under two years. Laid out in Springfield Park, on a site leased at a peppercorn rent from the local council, the track is an amenity of which the town may well be proud.

Another engine in steam on the opening day was Walter Jackson's 3½ in. gauge LMS 0-6-0 tank. She is largely to the *P. V. Baker* design, with slide valves instead of piston, and has been running for 12 years. Her builder, who is chairman of the club, says that her success has inspired two more members to make 5 in. gauge engines.

Then there was *Pinza*, Eddie Hinchliffe's version of LBSC's *Hielan' Lassie*. Readers building the engine from the instructions in MODEL ENGINEER may be assured that if they follow them properly they too will have [redacted] passenger-hauler of distinction.

NORTHERNER

Left: Walter Jackson, chairman of Rochdale club, braves the rain with a good head of steam on his 1F class LMS tank. Right: Eddie Hinchliffe, in driving hat, sees PINZA [redacted] *to the transporter from steaming bay to main track*

 Continued from 3 August, pages 134 to 136

Mark-space systems in practice

As used by the modeller, says RAYMOND F. STOCK, they are not completely independent of the pulse repetition rate

IN Fig. 24, the arrangement which is preferred in practice, the relay contacts energise a motor in opposite directions during mark and space, and their average effect is balanced against a spring which always tends to return the system to the neutral position. The main advantage is that the device is "fail-safe," as lack of motive power permits the rudder to go to neutral in an emergency.

A model aircraft is then likely to survive, as it certainly will not if it is subjected to prolonged full rudder, which invariably results in a nasty spiral dive. Of course, matters may be different in a boat; the owner of a marine craft may be able to preserve *sang froid* with the boat circling out of control—and may even look as if he meant it—but a boat disappearing in the distance on a straight course is embarrassing, and looks rather final.

The simple layout in Figs 23 and 24 is not appropriate for larger models; a more ambitious device is needed. We want a simple circuit reproducing all the essentials of a true servo system. Fig. 25 shows a block diagram of a true servo. Command signal *A* is compared in some suitable item *B* with feedback signal *C*, derived from *P*, which is any component capable of generating a signal proportional to rudder angle—such as a potentiometer (hence the *P*).

The two signals are compared in *B*, and any difference between them—indicating that the control position does not correspond with the value indicated by the command signal—is called the error signal. This error signal *E* is fed to a motor *M*, which turns the rudder *R* and potentiometer *P*, in such a sense as to eliminate the error. When the signal *C* has been made equal to *A* (as sensed by comparator *B*) no error signal remains and the motor stops. Thus, whenever the command signal alters (or the rudder moves, if that is possible) *B* restores the situation. This sounds rather involved; look at it in practice.

Fig. 26 shows a circuit lettered as before. The incoming signal *A* is, of course, a train of pulses, but we can regard it as being a variable current fed to one coil of relay *B*, as the inductance of the relay and the inertia of the armature can be supposed to "smooth" the pulses. Potentiometer *P* feeds a current *C* through the other coil of relay *B*, proportional to the position of the rudder. The double wound relay *B* acts as a comparator, its armature closing one or other contact depending on whether *C* is greater than *A* or *A* is greater than *C*. In the absence of any difference, there is no force deflecting the armature, which is spring-loaded to the centre.

Armature movement supplies power to motor *M*, of one polarity or the other, depending on the relative values of *A* and *C*. This is the error signal *E*, and because of it the motor rotates in one direction or the other to return the potentiometer (and, of course, the rudder) to its correct position.

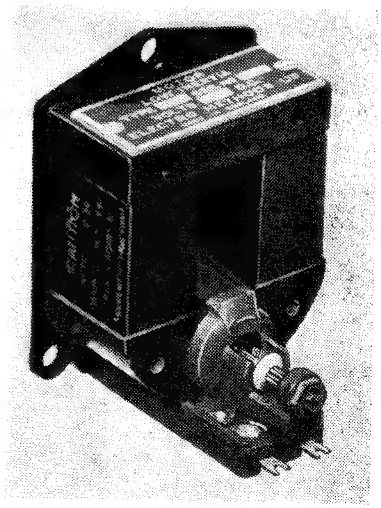
It is a practical circuit, but it would not give very precise results owing to the insensitivity of the relay. There must be a certain minimum current difference through the two coils of *B* before its armature shifts either way, and in terms of control this means a minimum angle by which the rudder can be wrongly set before the motor is energised; put more succinctly, the resolution of the system is low. To improve it, and assuming that it is impossible or unwise to increase the sensitivity of the relay, two expedients are possible. The magnitudes of *A* and *C* can be increased by raising the local voltages, so that a given minimum current change in *B* is produced by a smaller signal change; or error signal amplification can be employed. As the raising of local voltages cannot be pressed too far, we resort to amplification.

Fig. 27 shows a time-honoured circuit. In place of the double-wound relay two separate high-speed Siemens 3,400Ω relays (*R*1 and *R*2) are used in the anode circuit of a 3V4 pentode valve with h.t. of 90 volts. The relay contacts are connected to supply 6 v. to the motor, in opposite polarity as the relays change over.

Our valve grid is connected to the slider of a feedback potentiometer (100 kΩ) geared to the motor and connected across a 45 v. battery. The positive battery pole and the earth form the input leads, which receive the command voltage variable through 0-45 volt.

The difference between the input voltage and the voltage derived from the potentiometer is applied to the valve grid and appears, amplified, as a current change in the anode. One relay would be set to pull in at about 4.4 mA and drop out at about 4 mA, the other pulling in at 4.5 mA and dropping out at 4.1 mA. In these conditions the resolution should be about three or four per cent, or 1½-2 deg. over a normal range of rudder angle.

In Fig. 27 the input leads are dotted to join a potentiometer and battery, which I have shown so as to indicate more clearly the function of the circuit.



In this low-inertia motor for servo systems, hollow cylindrical armature winding rotates on a fixed iron core

Such an arrangement would, in fact, be used for bench testing and development; the potentiometer would be graduated, while a scale would be fitted beside the output gear so that readings could be compared. In the model the input must, of course, be derived from the channel relay, which can produce only current pulses. If they are sufficiently rapid, it is possible to effect considerable smoothing by a simple circuit.

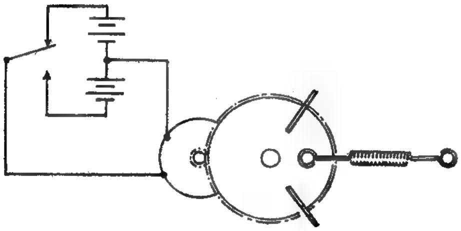
Fig. 28 shows the idea. On closing, the channel contacts complete the circuit through two resistors, the lower one shunted by a capacitor which charges up (not completely) and discharges through *R*2 during spaces—but its voltage cannot fluctuate widely at the pulse repetition rate, and the signal *A* applied to the servo input is a fair approximation to a smoothed value.

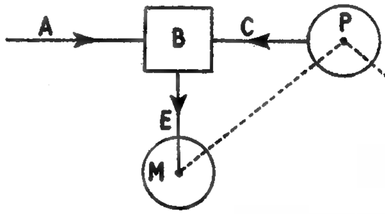
The actual resistances and capacitance used must be the subject of experiment as they depend on h.t. voltage, pulse rate and other factors special to any installation. The capacitor must not be made too large or it will prevent the signal voltage from changing at its fastest, as for instance in moving the control wheel hard over quickly for an emergency turn.

The ripple present in the command signal will tend to cause the anode relays to vibrate at its frequency, but this is not important and will be masked by another effect in practice.

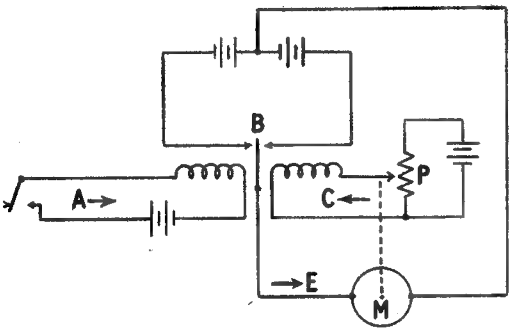
Owing to the inertia of the motor armature, the system must "run on" after power is cut off following a steering correction. This in turn applies an unwanted feedback signal from the feedback potentiometer, which may cause the motor to be energised in the opposite direction. If this happens the process may well continue indefinitely, the system continually hunting about a mean point. In fact there is no theoretical disadvantage in hunting provided it is of small amplitude and high speed, as it removes "stiction" from the gearing and so forth, and keeps the system lively. In practice it is usually undesirable.

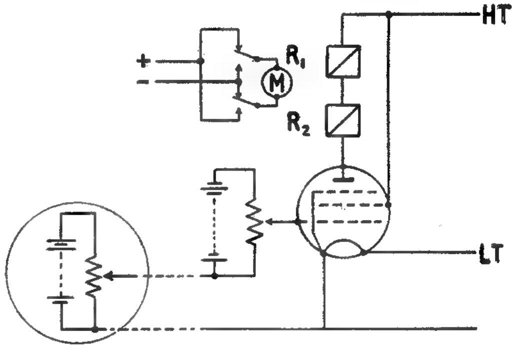
It can be countered by opening out the gap between the cut-in points of the two relays—but this reduces the



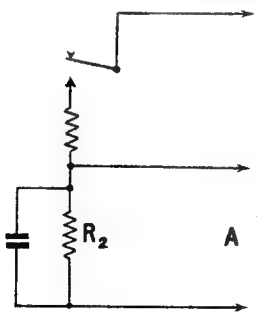


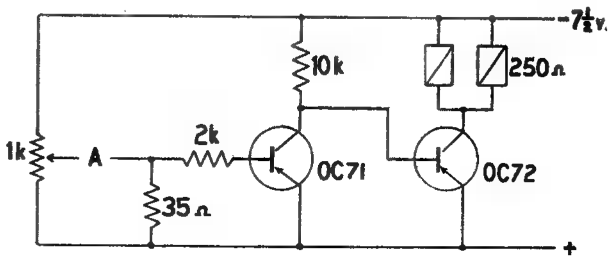
Left, Fig. 24: Spring-centred mark-space actuator. Right, Fig. 25: Here is a basic servo system



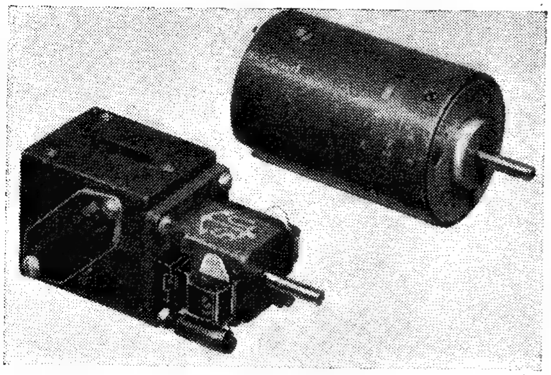


Left, Fig. 26: Practical servo system. Right, Fig. 27: Error signal amplification; modellers do not use the ringed parts in this form



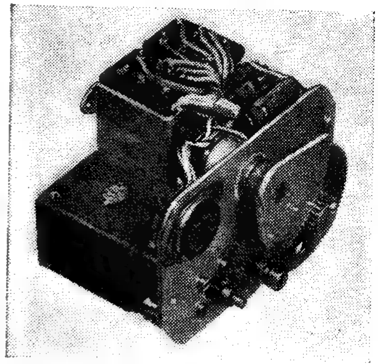


Left, Fig. 28: Pulse smoothing circuit. High-value electrolytic capacitors are suitable, and the relay contacts are connected to h.t. or to other positive supply. Right, Fig. 29: Transistorised error signal amplifier. Potentiometer applies feedback current in series with command signal A

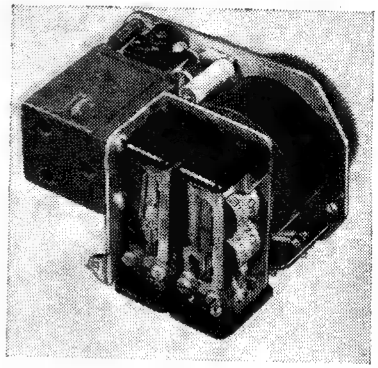


Left: Two familiar types of Government surplus motor—they have ball bearings and carbon brushes—used in servo work

Right: Servo unit, transistorised and compact. The space behind the socket holds other things



Below, right: Motor suppressor chokes and capacitors are mounted between the unit motor and the potentiometer, as is seen from beneath



sensitivity or resolution of the system. It is best, therefore, to prevent the overrun of the motor [redacted] far as possible. One way is by dynamic braking.

In Fig. 27 it will be [redacted] that, at rest, the motor control contacts of the two relays short out the motor armature. Thus, dynamic braking results from the motor's acting [redacted] generator on the overrun, and [redacted] short circuit throws a decelerating load on the motor. If this does not effect [redacted] suitable reduction in hunting, [redacted] friction pad on the motor shaft will curb its exuberance; the inefficiency of a permanent, lightly applied brake is unimportant. When really drastic steps are called for, it may be necessary to fit an electromagnetic brake to the motor. This consists of a drum or disc on the armature shaft in contact with a brake shoe held home by a spring. An electromagnet is wired in parallel with the motor and releases the brake whenever the motor is running.

Although [redacted] degree of hunting is permissible, it is often inadvisable for practical reasons, [redacted] in a state of continual starting and stopping (or reversing, which is worse) [redacted] motor consumes [redacted] disproportionate amount of power, and may be electrically overloaded.

Ideally, [redacted] servo motor should be specially designed for low inertia. This is the usual practice in full scale servo systems, but for model purposes we normally have to make do with surplus motors of an orthodox design. There is one small low inertia motor on the market, of German origin, but it is rather small and expensive.

Readers who have struggled through as far as this may well object to the multiplicity of power supplies inherent in Fig. 27. They are qiute right. The answer is, as usual, to transistorise the unit.

Fig. 29 shows [redacted] simple circuit employing two transistors. It will be [redacted] that the two motor control relays are now low resistance types (250Ω) in parallel to give [redacted] 125Ω load. The input signal *A* is variable (over the whole steering range) from 0-7½ volts.

Figs 30 and 31 are two views of an actual servo unit using [redacted] similar circuit to this. The unit employs [redacted] flange mounted surplus blower motor for power, geared down to [redacted] output gear sector giving 70 deg. movement. The penultimate gear is mounted directly on the shaft of a precision wire-wound 1,000Ω feedback potentiometer. Two Siemens high-speed relays are mounted at the back. Above the potentiometer are the electronics on a small etched circuit and below it the motor suppression components (chokes and capacitors). All connections (motor power, 7½ v. and command signal) are brought in through a 7-pin B7G socket on the gear plate. Output torque is normally taken from [redacted] arm bolted to the gear sector, and incorporating [redacted] ball joint for a push-pull rod.

With 12 v. on the motor the performance was:

Speed of response: 0.6 sec. Port to Starboard.

Output torque: 3½ oz. in.

Resolution: 2/3 deg.

Weight: 10 oz.

Dimensions: 3¼ in. × 2¾ in. × 2½ in.

The motor shaft was lightly damped to limit overrun, and the relays were adjusted as close [redacted] possible without incurring hunting. On completing small corrections of, say, 2-3 deg. the motor does not reach full speed, and follow-up is dead-beat. On large alterations of above 10 deg., the system oscillates twice at decreasing amplitudes before coming to rest. There is no objection at all to this overshoot, which is a quite normal attribute of efficient servo systems.

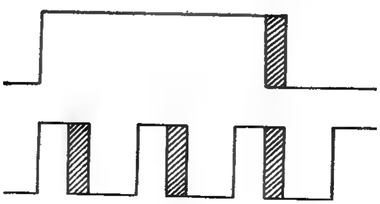
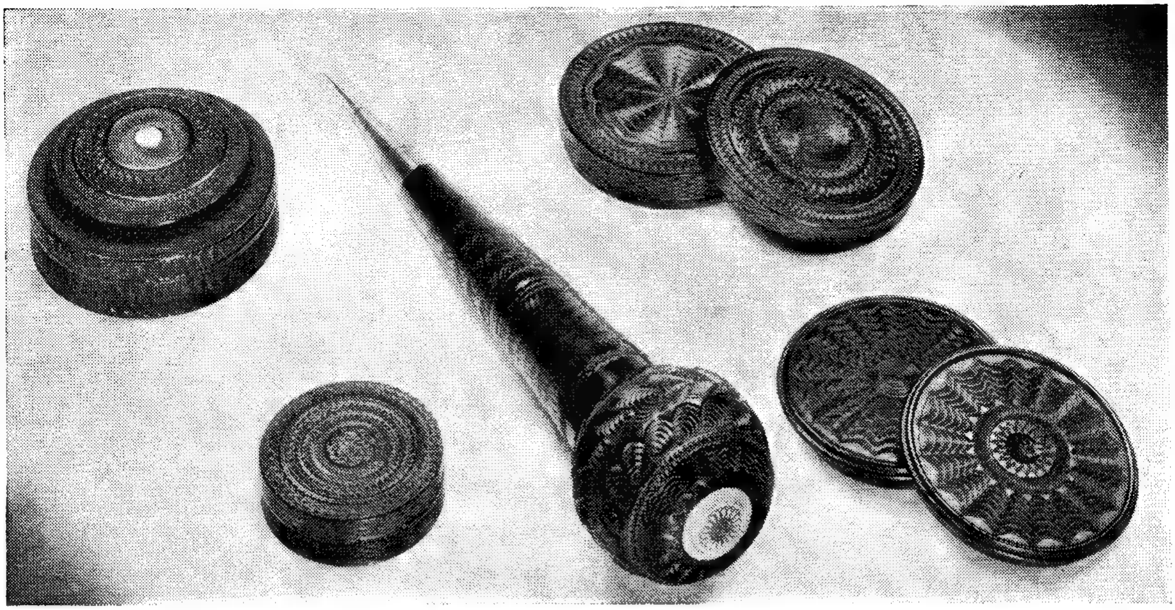


Fig. 32 Effect of time-lags on the fidelity of pulse handling

Theoretically, the mark-space class of systems [redacted] sensitive only to mark-space variation, and not to variations in the pulse repetition rate. In practice this is not so. The electronics may well handle 10 or 100 pulses a second with impartiality, but mechanical items, such [redacted] pulsing units and relays, seldom follow rapid pulses faithfully.

A contact brushing against [redacted] pulsing wheel, disc or drum will bounce at high speeds [redacted] it crosses the gap between segments, unless they can be efficiently insulated with [redacted] flush surface. Similarly, relays take [redacted] small but definite time to make or break. The result is to prevent the pulses handled from being accurately proportioned, and Fig. 32 shows how, with relay contacts, [redacted] operating time lag (shown shaded) may make only [redacted] few per cent difference to a slow pulse, but [redacted] major difference to [redacted] fast one. Consequently mark-space systems as commonly employed in models are *not* completely independent of pulse repetition rate.

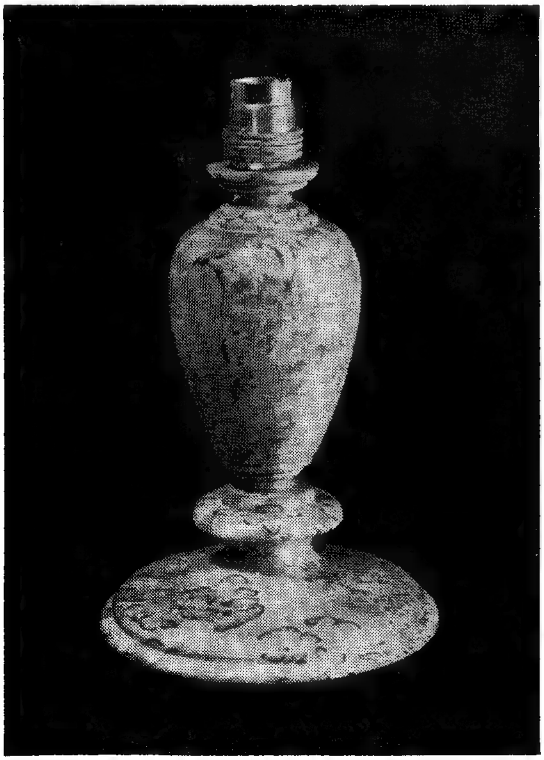
★ *To be continued* [redacted] *August* 31



Above: Work produced on Holtzapffel lathe with the usual accessories by D. C. Gall. Below: M. A. Bourne's lamp

ORNAMENTAL TURNING

EDGAR T. WESTBURY VISITS AN EXHIBITION



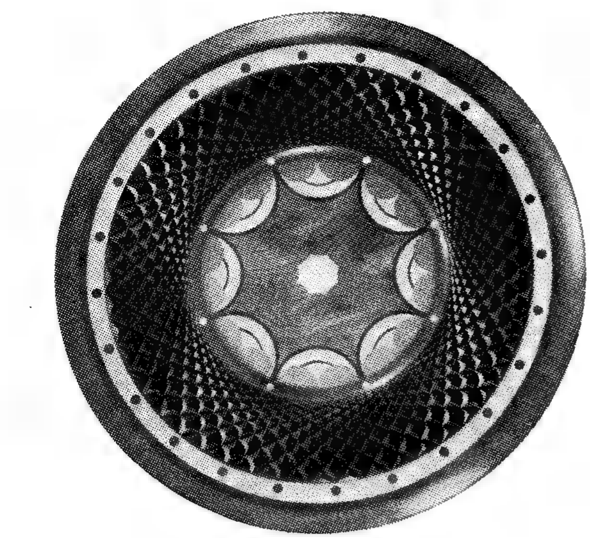
NEVER is the versatility of the lathe for executing complicated and unusual machining operations better demonstrated than in ornamental turning. Many wonderfully ingenious lathes and attachments for this class of work have been produced in the past, and at a recent exhibition organised by the Society of Ornamental Turners, excellent specimens of members' work were displayed, together with interesting pieces of old and new equipment.

The methods and techniques employed in ornamental turning, which vary widely, were all represented, ranging from simple articles such [illegible] bowls, vases and lamp standards, which can be produced by hand tools on [illegible] simple lathe, to relief-patterned objects of complex design, which involve indexing, eccentric cutting, and rose engine turning. Most of the articles were produced in wood or ivory, but there is [illegible] increasing interest in the possibilities of plastic materials such as acrylic resins, which are readily machinable, and [illegible] obtainable either opaque or transparent, and in various colours.

Inlaid patterns in wood or other materials of distinctive colours, and polychromatic specimens, produced by cementing together segments or lamina of distinctive colours and machining the surface to produce geometric patterns, provided scope for design and craftsmanship. Some of the exhibits incorporated several distinctive kinds of machining techniques, using equally varied materials, in a single specimen of work.

The exhibition was not competitive, and indeed it would be difficult to single out any specimens for special distinction, as the standard of workmanship was extremely high and the results obtained were not only clever but beautiful.

No less interesting were the pieces of equipment for ornamental turning, many of which were designed and made by the exhibitors, while others were relics of the old masters such as Holtzapffel and Evans. We saw the actual



Louis Berry made this inlaid wall plaque

tools and methods used by Holtzapffel in producing a silhouette portrait of Queen Victoria by mechanical means. An intricate type of geared geometric chuck, over 100 years old, attracted special attention. Owing to the overhang of the work table from the mandrel bearing, it was used with the axis vertical to avoid possible sag. The fit and finish of the slides, and their smooth operation, were remarkable, especially as no gibs were fitted for slide adjustment.

Other exhibits included useful literature on ornamental turning. Antique text books, some printed before the beginning of the 19th century, showed in numerous engravings what a great deal of ingenious work had already been done, even at that early date. Ornamental turning was once a very popular hobby among the nobility, and no expense was spared in producing the very best possible equipment; but prospective turners need not be deterred by the lack of suitable apparatus, as most of the operations involved can be carried out with home-made attachments to standard types of lathes.

The illustrations here are typical of the class of work shown, but do not necessarily represent actual exhibits. They were taken from the Society's periodical Bulletin, which contains descriptions of how these and other items were produced. Readers who are interested may obtain further information on the Society from the president, Mr A. H. Kelly, 36 Hill Rise, Cuffley, Hertfordshire. ■

SOUTH BEND GEARING

RECENTLY a British reader of MODEL ENGINEER wrote to me asking for help in rebuilding an incomplete South Bend lathe which he had lately bought. Among other data, he needed particulars of the apron gearing.

In answering him I turned up a rather interesting possibility, usable by anyone faced with a repair or replacement of the carriage (saddle) gear train of a Model A South Bend 9 in. swing "Workshop" type lathe.

The original function of subject gearing is merely to move the carriage along the bed, but its minor modification permits some sort of measurement of carriage movement to a fair degree of accuracy, corresponding to the error in reading a machinist's steel rule.

The gear arrangement is shown in the sketch, which also serves to define the symbols next used.

If we let t be the carriage movement per turn of handwheel,

$$\text{then } t = \frac{\pi n N}{gP} \text{ in.}$$

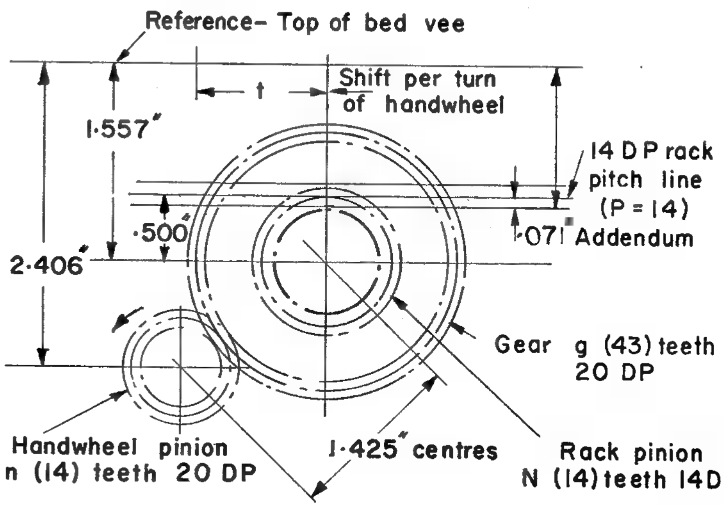
Approximating $\pi = 22/7$, for my own lathe, $t = \frac{22}{7} \times \frac{14}{43} \times \frac{14}{14} = \frac{44}{43}$, just over an inch.

Were g made with 44 t. instead of 43, then t would be just 1 in, which can be quite desirable. The periphery of the handwheel could be turned parallel for, say, a length of $\frac{5}{16}$ in., graduated either 64 or 100 divisions and marked, as preferred. Then the provision of a reference pointer would provide knowledge of carriage movement by either sixtyfourths or hundredths of an inch, and closer by interpolation.

Probable errors would chiefly be of two kinds, the first caused by the 22/7 approximation, accounting for about 0.0004 (four tenths) an inch, and the second caused by mis-spacing of teeth on an ordinary commercial grade steel rack—it can run as high as 0.0012 in. (twelve tenths) an inch averaged over one foot lengths. These errors may add or subtract, according to manufacturing means and methods.

If the apron gearing has to be overhauled or altered it is perfectly sensible to turn off the old 43 t., shrink on a new ring of the original outside diameter, and cut therein 44 t. of standard depth. This will run satisfactorily with a regular 14 t. pinion, and the new combination will make the graduated handwheel worthwhile.

I wonder why the original design did not match the arrangement outlined. My guess is that someone in authority must have wanted a hunting tooth effect in the design—a requirement I believe to be entirely unnecessary here.—R. V. HUTCHINSON



READERS' QUERIES

This free advice service is open to all readers. Queries must be within the scope of this journal and restricted to one problem. The replies published are extracts from fuller replies sent through the post: queries must not be sent with any other communications: valuations of models, or advice on selling cannot be given: stamped addressed envelope with each query. Mark envelope clearly "Query," Model Engineer, 19-20 Noel Street, London W1.

DO NOT FORGET THE QUERY COUPON ON THE LAST PAGE OF THIS ISSUE

Clock in Ontario

We have been thinking of building the gravity escapement clock, the instructions and specifications for which have been given in MODEL ENGINEER. On inquiring about materials, we have found that some of the most important are difficult or impossible to obtain, for instance, Invar steel and pinion steel of 7 and 12 teeth.

We could use any type of steel rod in place of the Invar, but there would be no point in building a clock that would not keep time. As for the pinions, we could make them but it would be much better to buy the pinion steel.—R.J.B., Arkona, Ontario.

▲ *T. W. Senier Ltd, St John Street, Clerkenwell, London, would be able to supply suitable pinion wire for the clock. The particular pitch of the pinions is almost equivalent to* 40 *diametral pitch.*

Invar steel for the pendulum rod is manufactured in Britain by Henry Wiggin, Sunderland House, Curzon Street, London, W1, and is also obtainable in suitable lengths for a one-second pendulum rod from the Synchronome Co. Ltd, Abbey Works, Mount Pleasant, Alperton, Middlesex.

Pump for aquarium

I wish to make a piston air pump for an aquarium. Could you tell me if the synchronous clock motors advertised in ME would be suitable for speed and power? If not, do you know of any small motors that would?

Are there any special ways of positioning the ports for an oscillating cylinder?—D.F., South Elmsall, Yorkshire.

▲ *It is not likely that the synchronous motor advertised in ME would be powerful enough to drive an aquarium pump, except possibly a very small one, and at a low speed. Certain synchronous motors on the surplus market can be adapted; it would be necessary to experiment with them to obtain successful results.*

An article describing a synchronous motor and pump for an aquarium by A. R. Turpin was published in ME of 26 *October* 1950, *and* 2 *November* 1950. *The first may be had from PM Sales Department at* 1*s.* 4*d.*

In locating parts for an oscillating cylinder, the essential point is that the single port in the cylinder should line up exactly with either of the ports in the port block at extreme positions of angularity, and that at either top or bottom centre the cylinder port should just close both the ports in the block. This calls for careful marking out and adjustment of the size of the three ports, but there is no way in which it could be simplified.

Making a refrigerator

Could you please tell me if it is possible to make a refrigerator of the compressor type in the home workshop? Is there any trouble in charging the system with gas?—C.E.H., Crich, Derbyshire.

▲ *PM Plans Service can supply a fully-detailed blueprint of a refrigerator including the compressor (Ref. G.*1, 6*s.* 6*d. for two sheets).*

There are certain difficulties in charging a refrigerator system, as it is absolutely essential to remove all traces of air and moisture before admitting the refrigerant gas. This should be done by a refrigerator service engineer, who will have all necessary facilities for the work.

It should not be difficult to adapt dimensions of the parts to suit any size, within reasonable limits.

Kiwi for cruiser

I am building a 57 in. model of a motor cruiser and am considering the method of propulsion. I rather fancy building the *Kiwi Mark II* by Edgar T. Westbury.

Will you kindly let me know if you consider the 15 c.c. model to be suitable, and also whether drawings and castings are obtainable?

I think that whatever engine is chosen it is essential, with my limited experience on the lathe, that the engine should have been the subject of a series in MODEL ENGINEER so that I can follow the operations stage by stage.—F.T.N., Manchester.

▲ The Kiwi Mk. II *will power this model but it might lack a turn of speed if that is required.*

As a motor cruiser is not supposed to emulate a speedboat and, apparently, you wish to gain experience in building a petrol engine, you are best advised to try the Kiwi. *The following drawings may be had from PM Plans Service: PE.*16, *The* Kiwi Mk II, *two sheets at* 5*s.* 6*d. each; PE.*12, *The* Kiwi *Automatic Carburettor, one sheet at* 3*s.* 6*d.; PE.*17, *The* Kiwi *Contact Breaker, one sheet at* 3*s.* 6*d.*

Castings may be obtained from Woking Precision Models Co. Ltd, of 3 *The Broadway, Woking, Surrey.*

Electric bellows

Could you please let me know how to convert a small bellows organ (122 reeds) to electric?—F.D., Hull, Yorkshire.

▲ *It would be possible to do this by using a motor with a suitable reduction gear driving a crank connected to the operating lever of the bellows. Geared motors with various output speeds could be used.*

Presumably you would require an output speed of about 60 *r.p.m. Motors of this type are obtainable from MR Supplies Ltd, New Oxford Street W1. The induction motor of about* 1/10 *h.p. complete with worm gearing is recommended. It is very quiet in operation, but it would probably be found necessary to introduce an automatic control to prevent overblowing—a matter for experiment.*

What lathe?

I am planning to begin model engineering. My interest is strongly inclined towards steam locomotives. I have read all the *Rob Roy* series to date and I think that *Rob Roy* would be a good first model. Later, all being well, I should like to build a BR class 9 or Pacific in $3\frac{1}{2}$ in. gauge. I have access at work to a fully equipped workshop where I could do occasional jobs in the lunch hour. But most of the work I shall do at home, and for this I need a lathe. I should like your advice on the size of lathe to buy and whether it need be a screwcutting model. My space and money are limited and so I do not want one larger than is necessary.—J.A.H., Eccleston, Lancashire.

▲ *The type of lathe suitable for constructing a* $3\frac{1}{2}$ *in. gauge locomotive would be around* $3\frac{1}{2}$ *in. centre height.*

Screwcutting is not essential, as all threads for model locomotive work can be cut by taps and dies. But it is a useful addition.

Such lathes as the Myford ML7 and Super 7, Zyto 3⅜ in., and the Portass 3⅝ in. would all be suitable. Where funds do not permit the purchase of a new lathe, a good second-hand one should be considered. The Pools Major 4 in., Drummond 3½ in., Milnes type R, Mellor 3½ in. and South Bend 8 in. swing are all excellent machines.

Up in the Blue Mountains

Having followed O gauge for many years (except for building a ¾ in. scale *Green Arrow* during the war) I am planning to construct a 1½ in. scale 4-8-2 heavy freight locomotive, similar to our own NSW D57 class. Are any detailed plans obtainable from your office of similar engines?

As age creeps on, the eyesight does not improve and the fingers become a little less nimble. I have found it necessary to concentrate on the larger scale.

Have you any available for a passenger-carrying well wagon in 1½ in. scale which I could scale up? Martin Evans excellently described the well wagon in ME of April 27, but I would prefer a fully-detailed drawing in this scale.

May I also thank you for so many happy and instructive hours of reading up here in the Blue Mountains of New South Wales?—J.W.G., Glenhook, New South Wales.

▲ *PM Plans Service cannot help you with drawings for a 1½ in. scale passenger truck; there is little demand for them in Britain. Your best plan would be to scale up in the ratio 3 : 2 the wagon described in* MODEL ENGINEER *for April 27.*

It is a pleasure to know that you enjoy MODEL ENGINEER. *All our readers will join in wishing you many years of happiness.*

Home workshop

I am proposing to set up a home workshop to make scale steam models. I should like some advice on what equipment and tools I would need and where I can obtain them.—B.B., Towcester.

▲ *If only life were as simple as your query appears to make it! No one can advise you what to buy without knowing what you intend to build. Generally speaking, model engineers equip their workshops gradually over the years.*

To make a stab at answering your question, you will need a small lathe of 2½ or 3½ in. centre height and the essential lathe tools, which you could make yourself from silver steel. Lathe and Shaping Machine Tools *by* Duplex *(3s. 10d. by post), and* The ME Lathe Manual *by Edgar T. Westbury (16s. by post) should help you.*

In addition, you will require a good selection of hand tools: scriber, dividers, centre punch, hammers, files, fraction and number twist drills, taps and dies. It might prove expensive to buy such things as drills and taps in sets; most engineers build them up by adding them as required.

Dolphin parts

I recently received a set of castings for the Dolphin 10 c.c. petrol engine which I am making to the detailed instructions in ME during 1955.

Several parts are missing from the castings, such as connecting rod, crankshaft, tappet guides, flywheel and valves. As I have never bought castings before, I presume one makes up these parts oneself.

Can you tell me the issues of ME which carried articles on cylinder boring and finishing? I have the issues from 1939 to 1959.

The wealth of information which ME provides on petrol engines is very much appreciated.—D.L.R., Greenford, Middlesex.

▲ *The parts to which you refer are not included in the kit of parts for the* DOLPHIN *engine; the intention is that they be fabricated, as you will discover if you browse through the original articles published from February to July 1956.*

Your other query about information on cylinder boring is a bit beyond the scope of Readers' Queries. To give you the dates on which articles on cylinder boring have appeared over the last 20 years involves research into 40 indexes. Perhaps a reader can help?

Steam mathematics

Can you tell me the amount of steam in pounds (not superheated) which will pass through a pipe of ¼ in. bore at 90 lb. pressure? At the same time could you let me know the calculation involved?—A.S., Leek, Staffordshire.

▲ *The amount of steam in pounds per second which you can pass through a nozzle can be calculated by the formula:*

$$M = \frac{a \times P}{70}$$

where M is the amount of steam in lb. per sec., a is the cross-sectional area of the throat in square inches, and P is the initial pressure in lb. per sq. in.

For a short pipe instead of a nozzle multiply the final figure by 0.93; for a hole in thin plate, multiply by 0.63.

For long pipes the calculation becomes very complicated. For instance:

$$M = 1.323250 \sqrt{\frac{P_1^2 - P_2^2}{P_1^2} \times \frac{P_1^2}{P_2^2} \times \frac{(D \times 12)^5}{CSL}}$$

cu. ft per hour.

where P_1 is the initial pressure in lb. per sq. in.; P_2 is the final pressure; D is the initial diameter of the pipe in feet; C is the coefficient of friction; S is the specific gravity of the steam; and L is the length of the pipe in feet.

Do not blame Readers' Queries if you have a headache.

Can You Help?

Readers who can offer information to those whose queries appear below are invited to write c/o Model Engineer. Letters will be forwarded.

Details of the Frazer-Nash

For a long time now I have been trying to find some blueprints of the Frazer-Nash TT racer, for the purpose of making a perfect scale model.

I wrote to the artist John Dunscombe and he referred me to you as he thought you could help.

I am not worried about the body so much, as I have a few photographs of the car. My main concern is to find the information on the chassis, engine and transmission.—K.M.P., Redland, Bristol.

There seems to be no one who can supply these prints. In any event, it would probably be rather difficult to obtain details of the engine and transmission, unless you were lucky enough to find an article dealing with the car in detail in one of the motoring journals.

You may be able to obtain some advice from the Editor of Motor Sport, *15 City Road, London EC1.*

Clayton engines

Looking through a 1932 issue of *Model Railway News* recently, I saw an illustration of a model of a Clayton locomotive whose original apparently operated in New Zealand. These engines would seem to offer interesting modelling possibilities, and I would be grateful for any general information about them, and references to any literature from which further details could be obtained.—A.A.N., Malvern.

POSTBAG

The Editor welcomes letters for these columns. A PM Book Voucher for 10s. 6d. will be paid for each picture printed. Letters may be condensed or edited

RALLIES IN NZ

Sir,—We are ardent readers of MODEL ENGINEER. We receive it about three months after publication, but nevertheless we enjoy it very much, and especially anything to do with the good old tractions.

There are quite a number of good tractions left in this island. Rallies are held in Canterbury and Otago about twice a year with about 30 engines present at most.

We had an attendance of 20,000. This is not so bad, considering the population, which is only about a million for the South Island.

Traction engines have gone up in price considerably in the last four years. An 8 h.p. compound Burrell, realized £425 at a sale a month ago. It was built in 1924, No 3974. An 8 h.p. compound Robey sold for £295. It was No 32701, built in 1914.

We have a Robey engine, which we use for a hobby, and at rallies within a radius of 50 miles.

Christchurch, New Zealand. G. W. Everest.

BEYOND DOUBT

Sir,—On page 532 of the *Railway Magazine* for August 1954 there is an illustration of North British Atlantic No. 869 carrying the name *Dundonian*.

Par, Cornwall. A. C. V. Kendall.

[*Robin Orchard was right.*—Editor].

FAST RUN

Sir,—I am somewhat puzzled by the letter from M. Turner of South Australia [Postbag of May 25]. Mr Turner says of his *Jubilee* that " our track runs for a length of a mile. I have been clocked at 30 seconds a lap. . . ." Surely this is incorrect, as this is a speed of 120 m.p.h. ?

On our club track at Temple Newsam I have been round in 1 min. 47 sec. for 1/5th mile start-to-stop, and this entails some pretty fast running. Surely Mr Turner's time is more like 300 sec., or 12 m.p.h. ?

" With the driver only, it will go round in mid-gear." This suggests that the engine is either not in mid-gear or that the piston or slide valves are not functioning correctly, thus allowing steam to enter the cylinders during some part of the stroke regardless of the position of the reversing lever.

Leeds. Peter N. Dean.

FINAL CHOICE

Sir,—I was extremely interested in the letter of Mr F. P. Robinson [Postbag, June 15], and the earlier letters from Mr F. Hendry]May 25], and Mr R. A. Ferguson [April 20] on the subject of Gresley Pacifics.

Admittedly, the BTC proposals for locomotive preservation are generous in the light of the considerable liability involved in space and money. But, like the other correspondents, I feel very strongly that one of the original Gresleys should have been included. *Mallard* undoubtedly has earned her place, but as two of these correspondents maintain, she is not particularly notable for elegance, whereas the A3s have all the beauty of line traditionally associated with Great Northern design from the time of Patrick Stirling.

Mr Ferguson suggested that either *Spearmint* or *Papyrus* would be suitable engines for retention, but I feel that the choice should fall on one of the original 12 A3s, and preferably on one of the first two, as they ran in GNR livery.

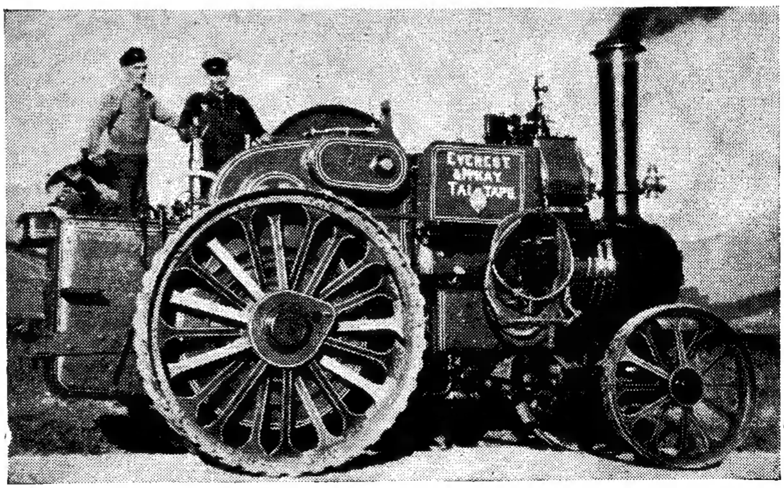
The *Great Northern* would have normally been the obvious choice, but she has been rebuilt almost out of recognition, and I, therefore, contend that the final choice is *Sir Frederick Banbury*, which ran for a short time in GNR colours before the grouping, and is still at work, I am assured, almost unchanged from her original condition.

It is very evident that the preservation of these engines would be more popular than the preservation of some of the locomotives in the present BTC list.

Nottingham. J. R. Smith.

BRAKES PROBLEM

Sir,—I am wondering whether any of your readers who have built *Hielan' Lassie* have fitted brakes. Although I am a long way from this stage I have been giving it some



As many as 20,000 may attend a traction engine rally in South Island, New Zealand, where MODEL ENGINEER *is ardently read. This Robey engine belongs to Everest and McKay of Tai Tapu. It travels to rallies within fifty miles*

thought, as I would like to have as many of the necessary holes drilled in the frames. As I see it, the big headache is in the leading wheels as there is insufficient room between the outside cylinders and bottom of the frame to fit a hanger pin.

I would be grateful if anyone could suggest a "fiddle" to overcome this, as I feel any locomotive looks unfinished without brakes, whether working or not.

Darlington. J. PARISH.

SUNDAY SHINE

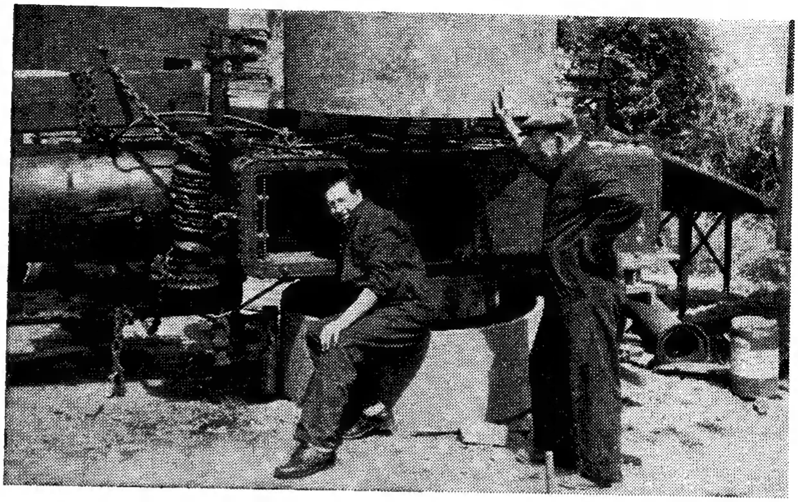
SIR,—The station in the Postbag illustration of June 8 is Liverpool Street. The Buck Jumper—the 0-6-0 tank—is in No 10 Platform, and the Claud in No 9a. The lamps were carbon arc lights, about 6 in. long by 1 in. diameter. They hung on wire and were wound down for cleaning while the electricians stood on a platform about 15 ft high. The globe was encased in a wire net.

The Claud was one of the first rebuilds. I believe that the original was first built in 1900 with round top tender and round front windows. She was later again rebuilt with round boiler (not Belpaire). We had 1818, 1819, 1900 and many other Clauds, including the two Royals 8783 and 8787, at Stratford. I began at Stratford in 1923 and with my mates, most of whom are now drivers, spent thousands of hours putting the shine on paint and steel which we and others admired (we did 16 years' cleaning). It was a sight to see Stratford sheds at 3 a.m. on a Sunday morning packed with engines of all sorts, about 400 of them.

For P.A.S. of Leicester [Can You Help ?, June 15] I have a photograph of the plaque on the cab side of 1379. It has been obtained for me by Mr Hardy, district running and maintenance engineer. I think that 1379 is now working in the Sheffield area.

Canning Town, London. C. C. YELVERTON.

Plaque on BR class B1 4-6-0, No 61379, C. C. Yelverton, who sends the picture, put in "thousands of hours" polishing the engines at Stratford



Repairing the boiler on an Aveling and Porter of 1908 (*engine No YV* 826) *bought by H. Bonnet from the Eddison Plant Company, in Hampshire*

REPAIRS

SIR,—I have bought an eight-ton steam roller, maker's number 12074, from the Eddison Plant Company at Bishop's Waltham, Hampshire. The engine was built in 1928, and needs a good deal of attention to the boiler and firebox before it can be made fit for the road. The fusible plug had been leaking badly over a long period and the firebox crownplate around the plug hole wasted down to ⅛ in. thick. Electric welding to build up the worn surround has been necessary, and I have had wasted places to build up in the firebox plate. Mr George Giles, a boiler expert, of Bishopstoke, has undertaken to do the boilerwork for me, and the pictures show him and his friend Rex with the roller on its side. We laid it over on the ground in order to make it easier for the boiler repairs to be carried out, with the help of a 20-ton crane for the job.

The roller, a compound piston valve engine, was built for the Islington Borough Council, but I am not sure how long it remained with them before it was taken over by the Eddison Steam Rolling Company, as it was formerly known.

As soon as the repairs are complete, the roller will be out and about again, displaying her bright brass rampant horse of Kent to the world once more.

The engine's registration No is YV 826.

Greenford, Middx. H. BONNETT

TOO SMALL

SIR,—Mr F. Raw's letter "Too Small" (Postbag, July 13) reminds me of the time when I was asked to vet a small compressor unit to find the reason for the motor getting too hot. On attempting to run the unit I found that the electric motor, owing to the load, was not reaching sufficient speed to operate the centrifugal switch and was consequently running on the starting winding.

As an experiment to overcome this I removed the two piston rings which were causing an enormous frictional drag, arguing on the principle that with the compressor direct-coupled to the 1,400 r.p.m. motor, considerably more air should get compressed than would leak by; a theory which proved correct. On top of the cylinder there was a release valve which I suggested should be operated until the motor reached full speed. I also advised that a little medium-body oil be supplied (through a screw-plug hole) to the piston before each use.

The owner was delighted.

Hastings, Sussex. MARTIN CLEEVE.

UNKNOWN TAPER

SIR,—I recently had the same problem as R.G.H. [Can You Help ?, June 22]—fitting a chuck with an unknown taper to a shaft for a toolpost drilling spindle.

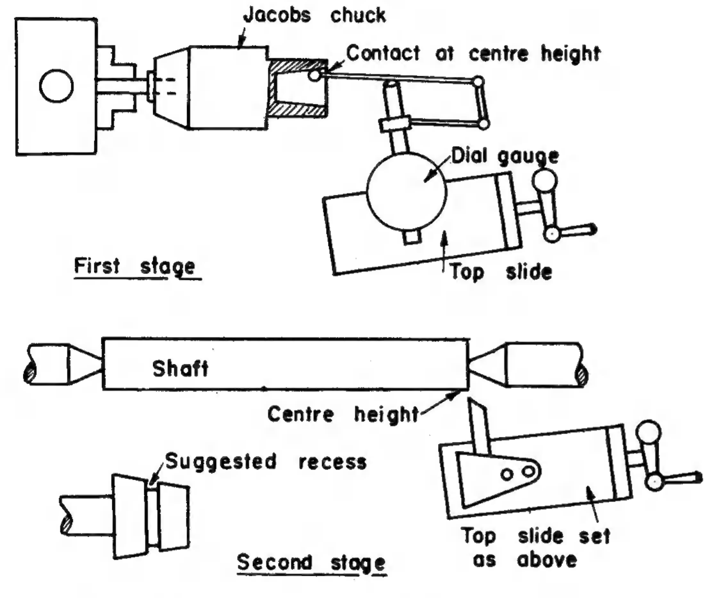
The method I used would not please some, but it worked. First, a short length of silver steel was put in the three-jaw chuck, and then the Jacobs chuck was clamped on to the protruding silver steel. When rotated, the back of the Jacobs was about 2½ thou out of true, and so I ignored it.

Then a dial gauge was clamped in the top slide, with its internal measuring device bearing on the inside of the Jacobs taper, on the back side of the lathe, as near as possible to centre height, by adjusting over the top slide until the dial reading remained steady. This gave the correct position to machine the drilling machine spindle, with the tool in the usual position.

A little blue, as mentioned in ME and a few touches with a fine file, and I was there.

I found that as my chuck was rather longer than a Jacobs, it was a good idea to give it a twist on the shaft with a small quantity of fine grinding paste, and to recess the middle of the taper as in my sketch.

Witney, Surrey. L. E. PERMAIN.



This is L. E. Permain's method of fitting a chuck with an unknown taper to a shaft for a toolpost drilling spindle

JAMES WATT

SIR,—I was interested in Mr Bradley's series of articles on James Watt, and particularly in the first instalment. I think that I can explain why Watt does not mention the opening of Cock No 2 in the experimental set-up shown in Fig. 2. The cock was probably left open all the time that the experiments were in progress, as, provided that the Cocks 1 and 3 are manipulated at the right time, the cycle of operations can be carried through without altering it. I believe that Watt's earliest engine had steam constantly on one side of the piston (the top side with the beam engine) and that control was entirely by the equilibrium and exhaust valves. To use the steam expansively an admission valve had to be added.

I am glad that Mr Bradley perpetuated the story of Humphrey Potter which some recent research workers seem to doubt, without I think any real evidence to support their doubt. It is a pleasant story and I should think it is very likely true.

What interested me most was the drawing of the atmospheric engine on page 428. This, of course, is neither a Newcomen engine nor a Watt, but one of the numerous bastard engines which were built in considerable numbers long after the Watt appeared. They had the open-topped cylinder of Newcomen combined with the condenser and air-pump of Watt.

They were favoured at first in an attempt to evade Watt's patents, and later because they were cheaper to build and maintain.

In the Midland coalfields they became very popular. They were usually much rougher than the one shown and were often without parallel motion, as with the open-topped cylinder, they would continue to work even when they were considerably out of line. The one in the drawing is a considerably more advanced design, with a cast iron frame capable of being easily dismantled and reassembled, and with a very complete arrangement of parallel motion apparently coupled to the pump rod as well.

I sometimes wonder if it represents an actual engine, as it seems to me that the parallel motion as shown is quite impracticable with its pump rod connection. It might guide the piston rod but it certainly would do curious things to the pump rod ! The drawing comes from Tredgold's book and is, I think, the work of Tredgold himself, but though I have spent hours trying to solve the problem and have referred it to interested friends, I have not been able to satisfy myself about it.

Another variation of the Newcomen engine was the "Pickle pot" in which the steam was condensed in a chamber (the pickle pot) immediately under the cylinder, but without an air pump. A winding engine of this sort continued at work until about 30 years ago when it was sent to Henry Ford's Museum in America. It was excellently illustrated and described in MODEL ENGINEER in, I think, 1931 by George Gentry.

The explanation of the two "original models" shown on page 427 is probably that the one in the Science Museum does not profess to be an original but is a very fine *working* model made in the Museum workshops. It is described in the Museum Handbook as a full-size copy of a model now in the Museum of King's College, London, and said to have been made in 1740, possibly by Dr J. T. Desaguliers. Many times, as a boy, I saw the model working under steam at the Science Museum, fired with a gas burner. I am not sure if it works regularly now. Its dimensions are given as 2¼ in. bore × 7¼ in. stroke.

The Glasgow College engine with which Watt conducted his early experiments was said by Smiles to be only 2 in. bore × 6 in. stroke. These figures are confirmed by Watt himself in his *Plain Story* of 1769, published in the *Life of Watt* by J. P. Muirhead in 1859, so it is clearly a different engine. I have an idea that it is preserved in Glasgow, but cannot at the moment find any confirmation.

Norwich. GEOFFREY K. KING.